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Port-a-map

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PORT - A - MAP

by

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CHAPTER I

INTRODUCTION

The purpose of this thesis is to develop high level design interactions between people and intelligent electronics to help in our daily lives.

The design will be a tool for traveling people, to help them move in the right direction. This will help them go faster and with safety. The design considerations will be based on the needs and the nature of the user. This design will meet stated objectives, some of which are to give the location, map information, and travel direction information.

To organize the thesis, the work will be divided into three parts: the problems and the supporting reasons that call for change, the research and the analysis for designing user interaction into the product, " Port - A - Map," and the design process.

Before a change occurs, its nature must be well understood so that design resources can be shaped to respond[1]. It is an interesting question for the designer nowadays: how to design while advanced technology offers almost unlimited possibilities for the function and quality of a product. At the same time, the use of intelligent electronics has increased rapidly in the design of numerous small appliances because of stimulation by cost reductions, resulting from technological advances. However, most of the products offer only sheer power. They lack the ability to communicate with the users. Research and design of user interaction should be done. The product, " Port - A - Map," will be analyzed and developed along this concept.

The art of finding the way by graphic map developed a very long time ago. Due to the

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[1]John Rheinfrank, "A Conceptual Framework for Designing User Interaction Into Product ", Innovation, Vol.3,No.2,1984., p.28

limited orientation ability of people[1], many devices were invented to help direct their movement from point to point. In this design development, the work concentrates on a tool for people who travel along a well marked system on land, such as roads. The device's features will be created from the evaluation of the needs, the human factors and the scenarios of user, and the technology available.

It has to be emphasized that the design of the Intelligent Mapping was done as a conceptual exercise. The research and the design for the product proceeded along the design development process of the industrial designer. For the designing user interaction, almost all concerns are about the environmental and human factors considerations of the user population including novice and non- technically trained people.[2] The device is possible to be operated with technology expected within the very near future. Reports on the electronic navigator market indicate rapid growth of advanced technology in this area.

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[1] For a detailed discussion of this matter see pp. 3-5 .

[2] Ben Shneiderman, " The Future of Interactive Systems and the Emergence of Direct Manipulation " in Human Factor and Interactive Computer System, ed. Yanis Vassiliou (New Jersey : ABLEX Publishing Corporation, 1984), p.2

CHAPTER II

PROBLEM DEFINITION

The process of directing the movement across land from one point to another emerged long ago. A number of methods have been used. Nowadays, people have a sufficiently well marked system for travel, i.e. streets or highways. However, they still have problems getting to their destinations. Losing the way means wasting time, money and pleasure, or it might be hazardous. Before the analysis occurs, the problem criteria should be established. There are two basic concerns that were observed:

1. The User
2. The Product

1. THE USER

1.1 Humans are born without orientation ability, so they need a direction finding tool.

The phrase, " a person's orientation, " is sometimes used to refer to one's ability to behave according to actual orientation, and sometimes used to describe the actual movements made in setting the body to a particular direction. Several studies have shown that man wasn't born with a sense of direction, one is the study by De Silva (1931)[1]on the boy with the magnificent sense of direction. The boy's abilities came from his mother who had been in the habit of using geographical direction when she indicated direction at home. To be a well oriented person, one needs to incorporate vision, man's most important modality for orientation.

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[1]Howard Templeton, Human Spatial Orientation, (London, New York, Sydney : John Wiley & Son, 1966), p.266

1.2 Ergonomics play an important role in the design of equipment to make it work for humans. This study shows that man's information processing, the most important ergonomics concern, has limited abilities. So it can be said that the second barrier for man in perceiving direction quickly with accuracy is his own information processing mechanism.

Specifically, ergonomics use detailed, quantitative knowledge about the human body to design tools and equipment which maximize productivity and safety while minimizing work and environmental stress for the maximum range of users. Ergonomics allow designers to capitalize on human capabilities while avoiding human limitations.

In the present day, an ergonomics model of Task/ Operator/ Machine/ Environment bases on a systems approach to modeling of human performance[1]. The attention is focused on the operator's behavior. This aspect also brings the information processing to an important ergonomic concern, because it influences human behavior[2]. However, these several different processes are limited by man's processing mechanism.

Attention The ability to selected task information while ignoring other information. We can't process all the information that is available to us at any one time. The problem is that people occasionally are misled into not attending quickly enough to the important information, a frequent cause of task errors and accidents. For example, checking map and road signs while driving fast.

Perception -The process that interprets, classifies and organizes arriving information. If one's perception of the expected outcome is at variance with the actual outcome then a problem exists. For example, observing the view in three-dimensions, then looking for the location on a two-dimensional map.

Memory - is our information storage system. A problem often occurs because of design inconsistency between similar tools that we use or because the mental load we are confronted with is too demanding, like the situation when we forgot the direction, even though we did study the map before the trip.

Decision making - The process by which we choose our course of action. People only have a limited capacity to make rapid decisions. If too many decisions are required too quickly, a

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[1]Colin G. Drury, Jasper E. Shealy and Sara J. Czaja, Ergonomics, (print.) p. 2-2

[2]Ibid., p. 7-1

person will have to trade off speed of decision making against accuracy of decision outcome. Like driving on the unfamiliar highway, it is hard to check the map and the road sign while, at the same time, paying attention to many fast moving vehicles.

1.3 Nowadays people are busier, and they have more activities that need to be done within less time than before. Also, high technology transportation is available for them to move faster. These changes mandate development of a navigation tool to keep up with the situation.

The United States benefits from the existence of a highly developed and extensive transportation network. In most instances, people have a choice of several different modes (or forms) of transportation to service their needs. The businessman contemplating a trip from New York to Boston may choose between airline, railroad, bus, or private automobile as a means of intercity travel.[1]

These advanced systems offer the traveller a chance to choose or combine in order to create their easiest trip. However the problem of losing the way still exists. Our direction finding tools are not yet so fast & flexible as our transportation system. The highway with plenty of signs doesn't mean no one gets lost any more. Traditional tools such as maps and compasses cannot work at high speed. Speedy tools like airplane navigation or ship navigation are tools specially made for each mode. They don't have the flexible usage features of the compass and map.

2. THE PRODUCT

2.1 Present direction finding devices resemble earlier performance tools. Later development hasn't improved anything to the point where the user interacts with the tool yet.

Formerly, land navigation, for the trip across unmarked areas, combined the same elements as navigation used at sea. Piloting, dead reckoning, and celestial navigation were used for travel across desert, tundra or ice. At least the north direction is needed to find the way on the map. However, man has a separate modality for geographic direction, which gives a direct awareness of the earth's magnetism. (Viguier, 1882).[2]

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[1] Robert C. Lieb, Transportation. The Domestic System, (Virginia : Prentice-Hall, 1978), p.8

[2] Templeton, Human Spatial Orientation, p. 625

One of the strongest conventions in cartography is the orientation of maps with north at the top.[1] It is a universal tendency recognized in both the art of composition and in the use of maps, that the top of the rectangle is " farther away in the direction a person is facing ". Notwithstanding the fact that for many centuries it was the standard practice to assign orientation on some logical basis, even if it was only religious or national interest, north orientation became fixed in cartographic methodology.[2]

From the point of view of education, north orientation has little justification. It has been defended on the grounds that it is fundamental to the teaching of shapes and areas.[3] North orientation has even less justification in function since an experienced map user automatically turns the map so that " top " is in the direction he is facing.

2.2 As the device existed for centuries, the later navigation came up with the same form as the earlier one. They still ask the user to adapt to them rather than asking the machine intelligence to adapt to the needs of an individual user. Instead, design deficiencies are still overcome by training and instruction manuals.[4]

Land navigation is the process of directing movement across land or ice from one point to another. It was believed that when travel is along a well-marked system of highways, trails, railways, etc., a good map and distance-measuring device are all that are needed. [5]The equipment used and the procedure followed should be suited to the circumstances. It is amazing that humans can evolve in terms of our system and tools much more quickly than in terms of our physical being.[6] So a high degree of common sense and adaptability are needed. It would be a waste of effort to

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[1]Arther H. Robinson, The Look of Maps (Medison : The University of Wisconsin Press, 1952), p.62

[2]Ibid.

[3]Ibid.

[4]Rheinfrank, " Designing User Interaction Product ", p.28

[5]Nathaniel Bowditch, American Practical Navigation, (Washington : US Navy Hydrographic Office, 1966), p.664

[6]John C. Thomas, " Organizing for Human Factor " in Human Factor and Interactive Computer System, ed. Yanis Vassiliou, p.32

measure accurately every change of course if one were following a stream whose general direction is known. But across an area without features, each change of course might be of great importance.[1]

Today's navigation differs fundamentally from that of just a decade ago. When the value of time increases, it becomes worth the effort to measure with speed and accuracy . The application of high technology to direction finding has become reasonable and economical.

In summary, these observations on navigation and its user reveal two problems : the problem of human limitations and the problem of navigation interaction irrelevant to the user. In order to solve these two problems, I have carefully planed my research in these two areas:

1. Navigation Technology

Since advanced technology demonstrates its power through most of present navigational techniques, the technique of former systems will be studied along with the latest system, the computerized navigation. This study will help the designer to understand the capability of modern systems. They can then create a tool which has broad capabilities, a tool which could possibly be used in the near future.

2. Human Factors

Ergonomics and the human - computer interaction are the focus studies. Because the product concept will be drawn mainly from both subjects, the user abilities will be the strong base for constructing the model of this user friendly product. Moreover, this model will be addressed as the solution for the final design.

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[1] Bowditch, American Navigation, p. 664

CHAPTER III

PRINCIPLES OF NAVIGATION

By examining the principles of current navigation devices and the variety of advanced technology applied to them, a conceptual system for this design can be constructed

The process of navigating a ship from here to there across the land or the sea can involve four methods, any combination or all of which may be used in a port - to - port passage.

1. PILOTING

In piloting for marine navigation, the navigator figures out where he is simply by looking at various visible landmarks and listening for helpful sounds such as a bell buoy or foghorn, and he steers his course accordingly. He may use objects on the shore or he may use any of the numerous buoys and other navigation aids that are found in coastal waters.[1]

In land navigation, piloting is generally quite simple, consisting merely of the recognition of landmarks, and notation of the time and distance at which they are passed. It is similar to the passage of buoys as one proceeds along a channel. Nowadays, because we travel along the modern traffic system, there is no need to take bearings with distant mountains when traveling in the open country any more.

2. DEAD RECKONING :

A term which derives from a contraction of the word "deduce" = "ded ". A course is laid out on a

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[1]Edward V. Lewis, Robert O'Brien, and the editor of Life, Ship (Time Life), (New York : Time Incorporated, 1965), p. 151

chart, and then the navigator estimates how far along that course he has traveled since he last estimated his position.[1] By means of the direction and distance traveled since leaving a known position, dead reckoning is used for determining the position of a ship.[2]

On land, dead reckoning is also the way to determine a traveler's position as well. The method, processed onto a chart, enables the traveler to pinpoint and correct an error. The chart used on land, which is today's road map, shows great detail. Both the selecting and following of a route are relatively simple. There are sufficient names and numbers of identifiable landmarks. Because the chart is already plotted as a well marked route, the map is not the chart used for plotting the route as before. In order to trace the route to any destination or to check the route for the change of course or speed error, the actual location is needed. This is determined by calculating direction and distance.

3. FIXING AN ERROR

At sea, the method of fixing an error is by using equipment to take a bearing. When the ship is in sight of land, the first step in getting a fix is finding a landmark and identifying it on the chart. Most fixes are obtained with a compass bearing on two landmarks, but if more than two are in sight, they can be used for additional accuracy. A celestial compass is another kind of navigation instrument which provides this type of a check when the ship is far from land and out of sight of any helpful landmarks. With this device, one's position is determined by reference to the position of the sun, moon or stars.

For land navigation, the method of fixing an error and tracing the route to the destination are by checking direction and distance, as follows :

3.1 Direction

As the trip is along a route which appears on the map, some kind of equipment is needed for telling which direction on the map is correct with regard to the front view being faced. The following tools had been in use when trips were primarily made over flat, open country or in rugged or wooded country; still, their main concepts are used to this present day :

a) The Magnetic Compass : This compass tends to align itself with the magnetic lines of

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[1]Lewis, Ship (Time Life), p.151

[2]Bowditch, American Navigation, p.664

the force of the earth. Because of its essential simplicity independent of any power supply or other service, a magnetic compass does not easily become totally inoperative, even through a ship's rigorous journey. The problem is, since it responds to any magnetic field, the original magnetic compass is affected by any change in the local magnetic situation, such as occurs when it is affixed onto a tanks.

b) The Gyro Compass : This compass seeks the true (geographic) meridian by the behavior exhibited in any rotating mass. The resulting precession causes the spin axis to trace a spiral path, eventually settling near the meridian. Since a gyro compass is not affected by a magnetic field, it has been used a lot in the areas of extensive deposits of magnetic material and especially in the vehicles where magnetic compass installations are difficult. With regard to its undesirable characteristics, the gyro compass is dependent upon a source of suitable electric power. Also, any disturbance during the operation of the compass can cause unreliable results.

For today's use, both of these compasses not only provide a directional reference and can be used as north-seeking compasses, but they have also been improved to the extent that they can operate as automatic systems. With this increased capability, they can provide direction even during a major change of course or speed.

c) The Sun Compass : This compass is a mechanical device for determining true directions by means of celestial bodies, principally the sun. It is free from magnetic disturbance and gyro error. However, there are limitations of observer position and time, for it must be used when the sun is visible. Generally this device is not used as a continuous indication of direction, but as a means of checking direction at intervals.

3.2 Distance

In land navigation, distance is usually determined directly rather than by means of speed and time. Speed may be used if constant enough, but this is rarely the case.

For a vehicle with wheels, the obvious method is by odometer, the distance-measuring device associated with a speedometer. For accurate results, such a device should be carefully calibrated. Size of tires, amount of tread left on tire, pressure, loading, speed of the vehicle, and nature of the surface over which the vehicle travels all affect the reading.

When traveling on foot, one can use a pedometer, a small, watch-sized instrument, usually attached to the belt, that records the number of steps taken. If this instrument is calibrated in distance, it should be adjusted to the length of step of the wearer.

4. ELECTRONIC NAVIGATION

Electronic navigation is plotting a position with the help of signals from a radio transmitter, radar equipment and other electronic devices. Advanced technology currently creates a number of sophisticated navigation instruments and navigation techniques for both land and sea. The description of these techniques are presented in the following chapter.

CHAPTER IV

STATE OF THE ART

Navigation Technology

It was said that navigation has changed from an art to a science since the advent of twentieth century electronics. However, both the most advanced aids as well as the simplest devices still rely on the same principle: that is, if a ship's speed and changes in course can be measured accurately, then its precise progress (and therefore its position) can be calculated. Advanced technology, by the means of present - day instruments, provides precise measurements for both land and sea navigation.

1. MARINE NAVIGATION

Modern ships have sophisticated electronic gear that provide navigating information of remarkable accuracy, for example :

1.1 An Electronic Echo

A sounder which bounces sound waves off the ocean floor, times the return of the echo and, from this information, reveals the contour of the bottom and the depth of the water.

1.2 A Radarscope

In the blackest night, a radarscope on the bridge yields the range and bearing of any sizable object up to 40 or 50 miles away.

1.3 RDF (Radio Direction Finder)

This device gives a ship its bearing when she is within range of a transmitter. A sensitive loop antenna on the vessel picks up a radio directional beam from a land based transmitter operating on a known frequency, and from that signal the captain learns his course or line of position.

1.4 LORAN (Long - Range Navigation)

With LORAN, effective for some 700 to 1,400 miles offshore, the ship receives synchronized, intersecting radio signals which give a position accurate within a tenth of a mile.

1.5 Navigational Satellite and Computerized Navigation System

In addition to the constant improvements in these systems, even more spectacular navigation aids are being introduced. In one system, specially programmed shipboard computers process data from the Navy's three navigational satellites and, in less than one second, give the vessel's position with great accuracy. The system is worldwide and operates in all weather. Also under development is bathymetric navigating equipment which enables a captain to locate his position by echo soundings over a previously surveyed and electronically mapped area of ocean floor. Scientists foresee the creation of strip maps of thousands of miles of ocean floor under the major sea-lanes to give the navigator identifiable landfalls beneath the water.[1]

Although not all ships carry computers which calculate their position by using signals received from satellites, most of them have other advanced electronic sets which have similar capability. If we were to look inside most modern ships at the crews' activities, we would see that the captain of the modern liner sets his course and leaves it to the automatic pilot to steer the ship. The slightest change in course is noticed by the gyro compass and passed on to the automatic pilot, which alters the setting of the rudder. In the meanwhile, an electronic log keeps a continuing record of speed and direction; ultrasonic depth-sounding (sonar) equipment measures and records the depth of the sea bed; automatic direction-finding equipment receives signals from a shore transmitter and plots the ship's course ; radar screens pick out any other ships in the vicinity ; and officers in the radio room are in constant contact with the shore and with other ships. There are regular weather, wave and ice reports. It is common to follow a route based on the most favorable wind and wave conditions, ather than on the shortest distance.[2]

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[1]Lewis, Ship (Time Life), p. 157 - 8

[2]Jonathan Rutland, SHIPS, (New York : Warwick Press, 1982), p. 12

2. LAND NAVIGATION

Since land navigation has the same basis as marine navigation , the same principles hold true for land vehicle. How they differ lies in the methods or devices used for measuring the changes in course and in the place of usage (sea to land). In order to show the applications of advanced technology for direction - finding on land, I will describe some current land navigation instruments.

2.1 Electronic Land Navigation

The most common electronic aid used is some form of radio direction finder (the directional characteristics of the loop antenna of a portable radio may be utilized) usually used in connection with a transmitter at the destination. In this system, the direction finder is used as a homing device. If signals from other radio transmitters at known locations can be received, a position can basically be determined by plotting two or more bearings.[1] However, many things can interfere with the transmission of radio waves on land, whether it be natural obstacles like cliffs, man-made obstacles like high buildings, or a city atmosphere filled with enormous wavelengths.

Like marine navigation, the four principle methods of land navigation (chapter III) are enhanced by advanced technology. Several types of mechanical dead reckoning equipment have been devised. One of them, " a vehicle direction and position indicator,"[2] is designed for vehicle installation and operates from the vehicle electrical system. With inputs from a gyro compass and the odometer drive, it automatically computes and continuously displays the vehicle position in map coordinates. It also computes and displays the distance and direction to a pre-selected destination. It is designed to be used with a map plotter which can plot the course followed.

2.2 Computerized Navigation System

A computerized navigation system for automotive travel, called " Etak," has recently been developed. This self-contained navigation system offers simple but valuable aids to drivers, such as showing their destination draw nearer as they proceed, making wrong turns immediately evident, and taking street names out of the night time darkness.

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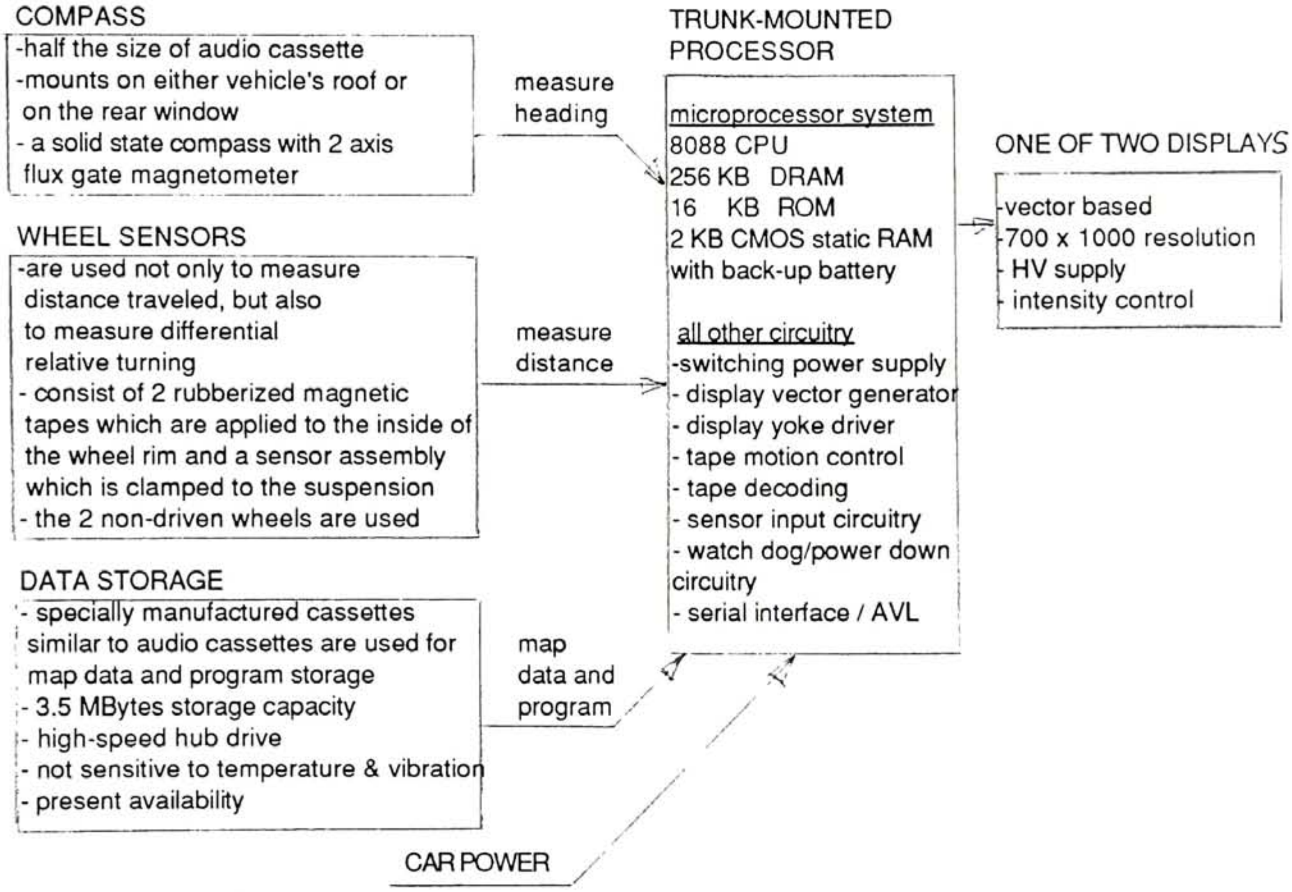
[1] Bowditch, American Navigation, p. 669

[2] Ibid., p. 665

Because this is a very interesting new approach to automotive navigation with map display, it will be described in detail.

a) The Hardware : This navigation system is packaged in three major parts : a processor, a cassette tape drive and a display, similar to the major parts of a computer. The other two parts are a solid state compass and two wheel sensors. (see figure 4.1)

figure 4.1 [1]



b) The Software : The programs run by the navigator are loaded from the map cassette. The system ROM is used to boot the main program, for navigation while booting, and for diagnostics This approach provides flexibility to accommodate future cassettes with enhanced navigation special databases and application.

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[1] ETAK Inc., " The ETAK Navigation, the World's First Automotive Navigation System ", (California : Etak Inc., 1984)(Press Kit)

c) The Navigation :

Dead reckoning : The advancing of a known position from measured courses and distances, which is the same technique as already explained. This car navigator used dead reckoning, with wheel sensor to measure distance, and differential wheel sensors and compass to measure heading.

- Augmented dead reckoning : The proper update which cancels the error accumulated in dead reckoning by comparing the actual vehicle's track to the digital map. For example, if the vehicle drives in an S curve, and the map has a nearby road with a corresponding S curve, cross-correlation between the vehicle's dead reckoned (DR) track and the S curved road on the map can yield an accurate positional update.

Besides these aspects of the navigation algorithms used in the navigator, other parameters for making decisions in updating the road network are stored on the map. These parameters include the connectivity of the road network, analysis of ambiguous update options, and estimates of the accuracy of the current DR position. Dead reckoning with map augmentation thus shows error statistics which are similar to radio navigation, independent of distance travelled.

- Self- calibration : The navigator uses comparisons between the map and the vehicle's dead reckoned track to continually improve the calibration of both the wheel and compass sensors.

d) Display :

The display is designed to display only the selective information needed by the driver and presents it in readable form at a glance.

- Limited complexity : Map scale can be changed by driver.

: The map data base selects the road to be displayed in priority by keeping the display complexity limited.

Selective labels : Only important streets, like streets near a selected destination or cross streets ahead, are labeled.

: Labels are always displayed right side up and are consistent in their size.

Heading up Presentation : The display corresponds to the driver's orientation by aligning with what is seen outside the window, so the driver can quickly grasp information sought from the map display.

e) Data Base :

The map is stored as a vector database rather than as images.

This allows the navigation algorithm to use the database for map matching. This will help find destination and formatting displays as a function of display scale, orientation, and road density.

f) Mapping :

A digital map data base is developed for use in the real-time vehicle navigation. The map area covers one fourth of the roads in a metropolitan area.

Applications are suggested such as routing, matching address field to coordinates, and for enhancing the Yellow Pages database.

CHAPTER V

HUMAN FACTORS

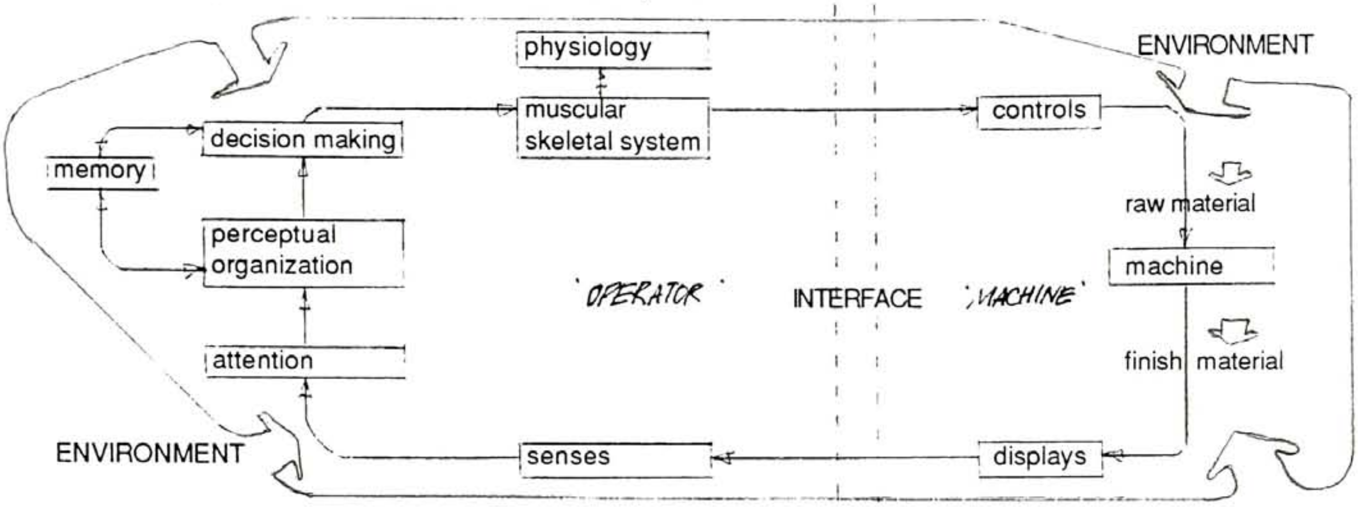
Man - Machine Interaction
The Human Computer Interface

MAN - MACHINE INTERACTION

In designing a system employing people and machines, we only have two choices for improving the human/ machine fit : change the human or change the machine. Changing the human involves selection and training, but this is not always possible. Changing the machine, by designing it " right the first time," is a better long-term solution, but selection and training may still be needed. Fortunately, the basis of selection, training, and ergonomic design are identified in a detailed analysis of the human-machine interaction called a Task Analysis.

The concept of the ' task ' aids us by opening up the methods used by human factors engineers in studying the complex interaction between the operator of a machine, the machine itself and the environment within which both operator and machine must work.

The Task/ Operator/ Machine/ Environment System:[1]



In this current model, there are four major subsystems ;

a) Task

b) Operator

c) Machine

d) Environment

When viewing human performance in the context of systems engineering, it becomes apparent that the overall goal should be the optimization of the system rather than any particular subsystem. Equally important in this context is a philosophical approach which is predicated upon the premise that most system failures do not take place because of human error or shortcomings, but rather because of mismatches between human capabilities and system demands. In order to ensure the success of the system, Task Analysis mentions the human factor as the necessary concern.

The classic method, Task Analysis (Meister, 1974) starts with a step-by-step description of the task, that is, how the operator interacts with the rest of the system. Each step of the task generates Task Demands, or requirements, that the operator must meet for successful task completion. These Task Demands are then compared with information from human factor data based on what humans can do on this task. Finally, the data bases must describe human capabilities and limitations in the same terms as the Task Demands.

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[1]Czja, Drury,Shealy,Ergonomics, p. 2-2

Goals of Task Analysis are:

1. Determine demand VS capability
2. Determine limiting subsystems
3. Alter Task/ Operator/ Machine/ Environment to remove or reduce limitation.

In order to reach these goals, human factors are the most important. This is why the human factor makes the system succeed. A human factors analyst needs to decide which aspects of task performance are limiting so that efforts can be concentrated on these aspects. A human factors understanding can help adjust a direction-finding tool or trip environment, and this understanding can be helpful in designing appropriate displays and controls that will enhance communication with the user and help him have a successful trip.

In man-machine interactions (see model p.19), the operator usually receives information about the progress of production from a display (a display refers to generally any man-made method of presenting information). The operator detects, receives and interprets this information and on the basis of his/ her interpretation, makes a decision and communicates this decision to the machine by using the controls. The control display then tells the operator the consequences of his action and the machine carries out the production process as programmed by the operator. Therefore, "human factors" are critical to any man-machine system.

Finally, in designing Port-A-Map so that it can be operated accurately and easily and adapted to the trip environment (trip with car or trip without car) to meet traveler needs, we must be aware of the human factors : the knowledge of the limits and capabilities of our sensory processes. These can be obtained by defining :

a) How people receive information from their surroundings.

b) How people process information from their surroundings.

RECEIVING INFORMATION

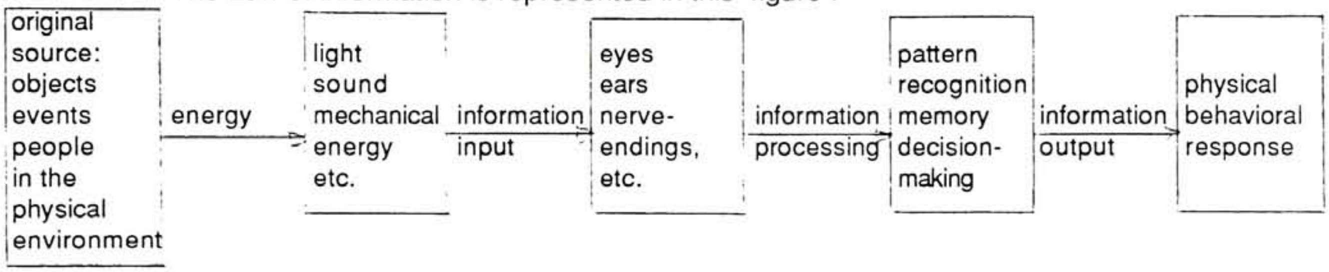
The following content will be about

- How people receive sensory information.
- What sensory capabilities are important for human performance.

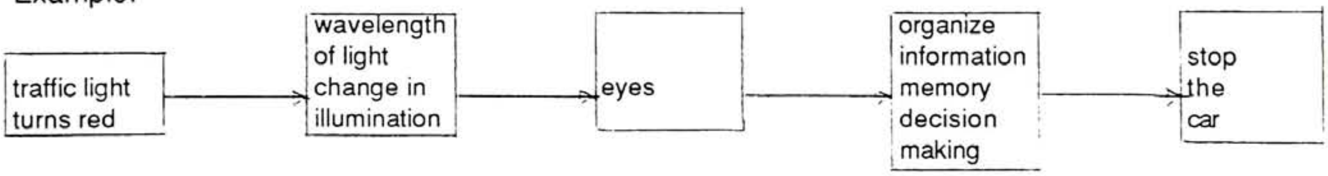
The way we receive information is through our senses. The senses serve as our channels for knowing about the world, the people, objects, and events in the external environment. A minimal list of man's senses includes : vision, hearing, the proprioceptive senses (sensing body position, body movement and forces exerted), the chemical senses (taste, smell), and the skin senses (temperature, pain, touch, pressure, vibration).

The interpretation of sensory input is generally a function of perceptual (e.g. pattern recognition) and cognitive processes (e.g. learning, memory). This interpretation in turn leads to some sort of response.

The flow of information is represented in this figure :



Example:



In designing and evaluating the work environment, important questions center upon whether the incoming energy (stimulus) is likely to be sensed and detected by an operator. The probability of detection is a function of both the input energy, background noise and the capabilities of the receiver.

First : The intensity at which a sound is detected depends upon the pitch of the sound and whether it is steady or modulated. Similarly, the detection of a warning light is not just a function of its intensity but of its size, color and interruption rate.

Second : There is the effect of the environment in which the stimulus is embedded. A sound is more difficult to detect in a noisy background ; a warning light is more difficult to detect on the main street of Las Vegas at night.

Third : There is the effect of the human. His senses may be affected by chronic defects (color blindness, low visual acuity) or by acute defects (not dark adapted, headache, illness).

In order to find the answer for designing Port-A-Map and evaluating its working environment, I will discuss the two major receiving senses : The Visual Sense and the Auditory Sense.

1. THE VISUAL SENSE

In most tasks we perform, we receive the majority of information we need for task performance from our visual system, i.e. written instructions, switch controls, warning lights.

Essential to a visual information system (flow of information from the environment to the eyes to the brain) is the ability of the operator to detect and identify any object, pattern or marking that he/she must see in order to perform successfully. It is important to realize that the visual system includes more than the eye.

a) Physiologically it includes the eye and the brain.

b) Psychologically it involves both the immediate visual sensation and past experience.

In other words, the visual information we receive is not only a function of physical energy, but also our interpretation of it which depends on perception and past experience.

We receive visual information in one of two ways :

Directly , i.e. direct observation of an airplane.

Indirectly , through some intervening mechanism or device such as T.V., Radar.

However, a person often needs more information than his unaided senses can detect ; in these circumstances successful human performance depends on the indirect presentation of information through the use of some type of visual display.

Ergonomic principles are critical in the design of visual displays. The efficiency in providing information is important. It is necessary that the information presented is correctly recognized and understood by the receiver. For example, CRT screens have little utility if the characters on the screen are too small and are illegible. Also, if a stimulus is a code or symbol of something, it is important that its meaning is understood, such as a red light serving as a warning signal.

There are a number of factors to be considered in designing a good visual display:

- size of the scale gradations.
- size and shape of the letters and figures.
- degree of luminance contrast, viewing distance, viewing time.
- color vision
- illumination , glare

In order to design displays which are effective and to be able to evaluate an environment or task in terms of the visual demands placed on an operator, it is necessary to have an understanding of the capabilities and limitations of the human visual system :

1. 1 Visibility : Detection of Light

Visibility is the ability to detect light. We cannot see any object in a completely dark room. The basic principle of visibility is an important consideration when examining the role of the human operator in a visual task. In insufficient light, an operator may not receive needed task information, or sometimes a warning light on an instrument panel is not bright enough and an operator may not be able to detect it.

1.2 Visual Capasity

The various functions of the eye are not usually pushed to the limits of their performance in everyday life. But this may sometimes occur under modern traffic or working conditions.

a) Acuteness of Vision : Acuteness of vision is the ability to see the finest details of objects and surfaces, the visual separation of points lying close to each other, and the appreciation of form and shape. Acuteness of vision is related to illumination and to the nature of the objects being seen:

Acuteness increases with the level of illumination, reaching a maximum of 5000 asb. (467.2 FL Foot Lamberts,USA). The increase is 150 % between 1 and 5000 asb.

- Acuteness increases with the contrast between the test symbol and its immediate background. The effect is greatest at the low end of the contrast scale.

- Acuteness is greater for dark figures on a light background than for the reverse.

b) Sensitivity to Contrast : Sensitivity to contrast means the ability to perceive the smallest differences in luminance, and thus to appreciate niceties of shading, small variations in tone, and the smallest nuances of brightness, all of which may be decisive in deciding about shape and form, i.e. for vision in depth. Sensitivity to contrast may be even more important than acuteness of vision in many jobs entailing inspection and quality control.

Sensitivity to contrast is subject to the following rules

- It is greater where big areas are involved than for small ones.

It is greater over shaped boundaries than when the change is gradual or indefinite.

It increases with the luminance of the surroundings and is greatest within the range of 200-10000 asb.

-It obeys the Weber-Fechner law and, within the range above, a contrast equal to about 2 % of the surrounding luminance can be detected.

It is greater when the outer parts of the visual field are darker than the center, and less in the reverse contrast. Maximum values are 1200-1500 asb. in the center and 100-300 asb. in the periphery.

c) Speed of Perception : Speed of perception is the time interval that elapses between the appearance of an object in the visual field and its perception by the brain. This speed increases with improved lighting and increased contrast between the object and its surroundings, as do acuteness of vision and sensitivity to contrast (but speed can be increased only up to the maximum speed of perception).

Either the speed of perception or, conversely, the minimum display time required for the object to be correctly identified, are commonly measured by the technique of tachistoscopy.[1]

2. THE AUDITORY SENSE

The physiological process of sound perception is essentially the same as that of visual perception. It serves as another important channel of information between man and the environment. In this case, the inner ear provides the " interface " at which sound-waves are converted into nervous impulses along the auditory nerve. The actual perception of sound is the integration and interpretation of these sensory impulses in the brain or, more precisely, in the auditory cortex.

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[1]E. Grandjean, Fitting the Task to the Man, (London: Taylor & Francis Ltd.,1982) p.123

The two principal functions of audition are:

a) To convey specific information: as a basis for communication between individuals, this function is highly developed in man. Speech serves as an important means of information transfer.

b) As an alarm system: by activating secondary pathways leading to the brain, it plays an essential part in waking up, in increasing alertness and, finally, in activating alarm.

The perception of sound does not yield a faithful reproduction of the whole bond of frequencies, which is simply " played " in the brain. This fact is especially important with regard to people's reaction to noise, which varies greatly from person to person. What is noise to one may be music to another, or the noise that generally activates alarm doesn't work any more for a person who always experiences a false alarm Another example of varying perception is the assessment of loudness in relation to pitch. In practice, low-pitched sounds seem less loud than shrill ones, even though the energy content may be the same.

In using the auditory sense system to transmit information either through the use of auditory display (receive information indirectly through warning and alarm signals, telephone, etc.) or speech communication, a number of factors affect a person's ability to detect and discriminate sounds.

2.1 Individual Factors:

- Hearing ability of individuals.
- Age.
- Experience of individuals.
- Length of exposure to background noise.

2.2 Signal Characteristics:

- Sound intensity and frequency.
- Sound duration.
- Rate of sound occurrence.
- Probability of signal occurring

2.3 Environmental Factors:

- Type and amount of background noise.
- Size of room in which the noise is occurring

DETERMINING WHETHER TO USE AN AUDITORY OR VISUAL FORM OF PRESENTING INFORMATION

Hearing is second only to vision in providing information through which we can know, learn and adjust to our surroundings. Besides the obvious fact that hearing involves ears and seeing involves eyes, hearing may be distinguished from vision in these ways :

1. Audition is characterized by being a linear sequence in time, whereas vision tends to be more of a gestalt type experience.

2. Consequently, audition tends to have a slower rate of information transfer when measured in bit per unit of time.

3. Audition is more non-directional than vision, i.e. a sound may gain our attention even if its source is behind us or obscured by another object.

4. Because of its relative slowness and non-directionality, auditory signals tend to be better for qualitative rather than quantitative messages such as warnings.

The decision on when to use an auditory or visual form of presentation of information depends on the nature of the message or signal, the conditions under which it must be received and the characteristics of the persons involved. The alarm function of the sense of hearing may be used to advantage in planning transport and in industry, because it is essential to recognize dangerous situations quickly. The presenting information function is often used when the visual system of the person is overburdened (such as when the operator has to monitor a complex visual display or when a driver has to drive a car while checking a navigational screen) and some sort of auditory signal, such as a buzzer, is used to alert the operator to any type of equipment malfunction or to alert a driver to the next turn.

In spite of the fact that the vision signal is better for imparting quantitative information, in the final analysis, a suitable combination of acoustic signals and visual aids is needed. This will result in a system where the acoustic signals serve to "alert" the brain and the visual aids convey the necessary information, such as street map.

INFORMATION PROCESSING

Information processing is an important ergonomic concern because of its influence on behavior. For instance, the behavior of people at work is a consequence of information processing. From the model of human performance (p.19), in which information processing constitutes the major portion of the model, the consequence process is illustrated :

From the senses, signals come which correspond to the sense-organ's stimulation.

These signals are conducted along nerves to the brain and acted upon by complex processing mechanisms.

These processing mechanisms interpret and give meaning to the sensory information.

There are four different processes involved in the flow of information processing: the attention, the perception, the memory and the decision-making.

To make any improvement in information processing in order to maximize productivity, quality and safety, the discussion throughout of attention, perception, memory and decision-making will be proceeded from the following precepts :

1. The human operator behaves like a single channel information processing device, in that he/she can only make active decisions about one thing at a time.
2. The human operator behaves as if he has a limited channel capacity and, hence, processes information at a constant rate.[1]
3. However, the operator can choose a different strategy ; he can decide not to process all the information and, thus, accept a higher rate of errors.
4. The speed/error trade-off is an important concept in ergonomics and shows that, unless we alter the situation, any increase in speed will be bought at the expense of an increase in the probability of error. If we want to both improve speed and reduce error, we must either :

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[1]Proceeding from assumptions 1) & 2) the information content of a decision can be measured in a bit, as expressed in the following equation:

Amount of Information, BITS = Log_2 (number of alternatives)

(The information content of a decision is a function of the number of possible alternatives. Which particular choice is in fact made, i.e. right or wrong, is of no concern, only the range of possible choices.)

a) Cut down the number of alternatives, that is simplify the job, or

b) Increase the rate of processing information (e.g. from 1 bit/second to 2 bit/second) by selection, training, or ergonomic redesign of the machine.

Since my main purpose in this project is to redesign the direction finding tool ergonomically, human factors constitute a significant consideration. In the following discussion, I will focus upon the capability of each information processing channel relevant to the design analysis of navigating tools.

1. ATTENTION

Attention is our ability to perform selective analysis of inputs. The human information processing system is viewed as a "single channel." Because of the limited capacity of our information processing system, we cannot process all of the information that is available to us at any one time. In order for us to perform a task, we need to select out task information while ignoring other information. Attention is defined as our ability to do this.

Attention consists of two interesting different systems :

a) Selective Attention: whereby inputs are voluntarily attended to. It is the conscious decision-making procedure that initiates and directs voluntary action, such as a machine monitor operating a complex visual display.

b) Unconscious Monitoring: which refers to our awareness of environment even when we are not consciously attending to it.

The problem of attention, hence, is to maintain the balance between these two processes,so that, for instance, a machine operator monitoring a complex visual display will not fail to notice a flashing warning signal indicating system. In order to minimize the possibility of failure:

1.1 Information should arrive in well proportioned and in an organized order.

Generally, in most task situations, we have to attend to a multitude of inputs and typically we switch our attention from one input to another. If the information sources were organized and the amount of information that we focus our attention upon was in proportion, the work can be done, as when pilots monitor their flights or when drivers scan the road while consulting a map.

1.2 If the total information rate from all inputs exceeds the capacity of the channel to process that information, load shedding occurs and, in effect,:

a) Reduces the number of inputs by not attending to the less important ones.

b) Processes less information about some inputs by accepting a higher rate of errors.

c)Slows down the rate of the arrival of information in cases where the task pace is controlled by the operator.

In order to illustrate this load shedding process, let us take an example a person who is in a hurry and driving to town X at top speed. The best that he can do is to attend to the critical input to maintaining control of his car and to look for the town sign, measures which preclude checking the map . In such a case, most people would accept the possibility of getting lost rather than study the map while driving. In order to be able to check the map while driving and looking for the road sign, he needs to lower the speed of his car.

1.3 Any factors which increase uncertainty or decrease the information processing rate will contribute to information overload. Incompatible controls and displays are obvious examples, although transferring between machines with non-standardized controls or having to choose between too many identical switches can also contribute to overload. These design faults may not show up during normal use but may be critical in information-overloaded conditions.

2. PERCEPTION

Because of the rather limited information processing capability of humans (both in terms of speed and quantity), it is necessary for humans to use certain simplifying procedures to speed up the recognition process :

a) Past experience becomes the main function used to simplify and organize vast amounts of information that first come into the senses and are of sufficient strength and/or interest to gain the human's attention. For instance, one might divide a group of travelers according to preference based upon past experience, one group being those who prefer determining direction by consulting a map and another group being those who prefer following a written description of the direction.

b) The recognition aspects of perceptual organization involve the use of heuristics by only attending to the details that are necessary to distinguish complex things and patterns. This process involves a number of different techniques that tend to improve with training and experience.

c) Direction Experience.

d) If the traveller's perception of the expected outcome is at variance with the actual outcome, then the problem exists. On the positive side, if we can design the job so that it fits in with perceptual organization of both traveller groups, the work can be done more quickly and more easily.

We perceive information from our environment in the following ways:

2.1 Gestalt

Since the early 20th century, psychologists have recognized that people see and hear their environment in terms of whole entities rather than as unrelated parts. The perception of an object as a whole in this way is referred to by the German word 'Gestalt'.

a) Figure and Ground: We see objects as standing out against a background, as figures on a ground rather than merely adjacent patches of color, like the tool against the work bench. We also have figure/ground relationships in hearing, such as the coffee break chime against a background of factory noise.

b) Grouping: It can be seen that grouping reduces the information which needs to be processed. On a control panel, people can easily find 12 switches if they are grouped as 6x pairs, 4x triplets or 3x quadruplets. It is much more difficult with grouping above 5xquadruplets or ungrouping.

2.2 Contour

The boundary between two colors or qualities of brightness is a contour and we perceive shapes of objects largely in terms of contours. The symbol mark illustrates many of the concepts of perception, but most importantly it emphasizes contour. The good Gestalt of the outline drawing carries the impression of reality. The symbol mark may convey information faster than written words.

2.3 Direction of Movement

Finally, under perceptual organization, we have certain organizing rules imposed by a technological society. There are two questions to ask in investigating a mismatch between design and a population stereotype:

a) Does the design go against a population stereotype, e.g. a piece of British Electrical equipment where switches go down for on ?

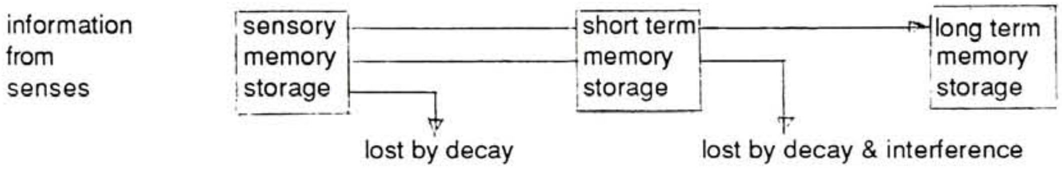
b) Does the design fall between two possible interpretations, i.e. "clockwise for increase" can conflict with the stereotype of "nearest point on knob moves with pointer"?

3. MEMORY

Memory plays an important role in our successful performance of day-to-day tasks. It is involved in everything we do. Memory failures can be of considerable consequence and can be the cause for a breakdown in the interaction between man, machine and the environment.

In the general model of human performance, an operator's task behavior relies heavily on past experience and learning, i.e. information that has been stored in memory . Without this ability to retrieve and store information, we would not be able to learn from our experience or recognize anything.

The three stages of memory :



3.1 Sensory Memory

This memory store is specific to the sensory system being stimulated, such as Visual Information that is held in the visual sensory store. This memory system maintains a detailed image of the information that has arrived at a particular sense organ. Storage in sensory memory is very brief and information is usually held in this memory stage for fractions of a second. This helps to explain why, when we start to write down a phone number which has been displayed briefly on the TV screen, we forget the rest of the number - it has been lost from sensory storage. The problem is that the process of readout into short term memory is slow enough that information in sensory storage can decay.

3.2 Short Term Memory (or Primary Memory)

Short Term Memory is the immediate memory of some type of stimulus (object, event). It is the stage where we maintain information that we need for a few minutes or information that we are trying to organize and encode into long term memory.

Two important characteristics of short term memory are:

a) Its short duration is only a matter of seconds (which is still longer than the sensory storage).

b) Its capacity is limited to 7 + 2 independent chunks of information. For example, a telephone number (7 digits) with an area code (3 digits) will be easier to remember when it is grouped into 3 chunks of information, i.e. (___)-___ ____

Because of its auditory nature, short term memory is susceptible to auditory errors (V, T, and 3 ,or CAT and MAT, etc.) rather than visual errors or errors of meaning.

3.3 Long Term Memory or Secondary Memory

Long Term Memory is relatively permanent memory store. It contains all of the knowledge that we have acquired during our lifetime. Long term memory differs from short term memory in its capacity to be limitless.

The major task in learning new material is to integrate it within the structure of information already in the long term store. Therefore, the rehearsal of new information must involve more than repetition; it must involve a deeper level of processing. The more the processing makes use of associations between the new information and information already in memory, the better will be the later retrieval of that information for use.

The information which is passed into long term memory can be not only in auditory, verbal or linguistic terms, but also in visual, taste olfactory and even temporal terms. It is typically coded by its meaning to the individual, that is by whichever dimension is likely to be relevant for retrieval.

To give some understanding of the different stages of memory, they can be considered through this example. Each stage has a different relation to a task : at the control panel, the limited capacity of sensory memory limits the speed at which an operator can scan a visual display. The limits of short term memory can limit the operator's capacity to identify which step in a task sequence he has just completed. Problems with long term memory can limit the capacity to recall which switch is used for which operation.

There are a number of factors which influence how well material is remembered (or how easy it is to learn to use the tool). Some of the most important factors are the degree to which the original material was learned (which also depends on motivation, i.e. the desire to learn), previous learning, anxiety, and the learning method or training.

4. DECISION MAKING

The human is considered an information processing device. It is interesting that what determines this is:

4.1 The amount of information in a task.

4.2 How quickly we can process it and,how and why we make errors.

Decision speed and accuracy : People have only a limited capacity to make rapid decisions. If too many decisions are required too quickly, a person will have to trade off ' speed ' of decision making against ' accuracy 'of decision outcome.

4.3 How to decrease the amount of information we need to process.

4.4 Movement needs controlling, which also requires information processing.

a) Decision making in movement control: People are limited to about 2 to 6 bits per second for reasonably compatible material. But the central decision making mechanism has other things to do apart from making these overt task decisions. It must monitor the environment and monitor the body functions to make sure that all is well. It may even do things which are not directly task related such as listening to the radio while driving or whistling a tune while sawing. We considered these processes under "Attention", but must consider one of them again in this section i.e. monitoring of bodily functions, in particular, monitoring control of movements.

In learning a skill, people start with ' close loop control ', as when a person learning to drive glances down to see where the pedals are. When movements become ' ballistic '(skill becomes progressive), it is called 'open loop control.'

b) Sharing and sequencing (doing two things at once) : Time Sharing is our single information processing decision-maker between two or more tasks. There are only two ways we can do this and appear to do all things at once :

Alternate : the two tasks by doing a little of one and then a little of the other.

Delegate : do one of the tasks so that it does not need decision-making control. This is the basis of most skills where movements are initiated as a sequence and controlled 'only by a lower-level kinesthetics control. From the central decision-maker's point of view, these would be considered ballistic movements.

THE HUMAN-COMPUTER INTERFACE

Currently, automated system technology is undergoing revolutionary changes. The rapid metamorphosis of large computers into small numerously distributed appliances was stimulated by cost reductions resulting from dramatic technological advances. Large scale integrated circuitry reduced the cost of computation a million - fold during the last three decades, while reliability and speed increased. Because of these changes, the challenge of harnessing these computational resources has moved to the human factor arena.

I project that the practical range of tomorrow's computer applications depends heavily upon the successful development of acceptable interfaces. This is because few people, other than researchers or hobbyists, buy computers to program them. Users' interests are not, in general, concerned with programming but with the utility of the end product. This will often depend on how easy the system is to use.

It has been argued that there (now) exists over 20 years of experience in designing interactive computer systems, yet there are still no production techniques for dialog design on a fully specified, scheduled, quality controlled basis. A control principle for successful design was recognized a considerable time ago (Petri, 1962), but has never been thoroughly implemented. In recent years a new subject area has developed with the objective of exploring principles and methods for adapting computer systems to human needs. The subject is frequently designated by such terms as "interface design" and "dialog engineering."

In order to perform design development concerning "interface design", we need its conceptual basis to guide our understanding of user-device interaction so as to support design decision making. These will be obtained by exploring :

FIRST : The definition of user-device interaction.

SECOND : Several design issues and hypotheses relevant to improving user interface. Hopefully, they will provide insight for future work, as well as the incentive to do a better job next time.

THE DEFINITION OF USER-DEVICE INTERACTION.

The definition of user-device interaction was partitioned into nine overlapping principles. The principles contain insights into how people perceive, think and act in such a communication environment.[1]

1. Environment : An analysis of the ecology of user influences possible in a product environment (e.g. heat, surrounding activity, noise level). It allows design decision-makers to develop a mutually enabling relationship between the scope's spatial, temporal and conceptual dimensions.

2. Self-Evidence : The interaction within the communicative environment which provides information about what action the user can safely and effectively perform. The relationship's success depends on affordable in the environment to which the user is sensitive.

3. Mapping : Development of a dialogue between a person and a designed object involves mapping the interaction in the user's mind. Mapping is used to represent both structural informational elements such as machine parts and procedural information, such as how to use the machine.

4. Congruence : Good dialogue design seeks to construct machine processes congruent with the users' mental processes. Ideally, the users' models of the machine match the machine's models of the users.

5. User Differences : Dialogue design should embrace individuality along the full range of the users' capacities. While designers can accommodate motor and sensory differences with adjustability or customization, programmers can accommodate cognitive differences by designing the system to accumulate knowledge about the user and thereby act appropriately.

6. Metaphor : People can more easily understand a new concept if its presentation connects it to an already familiar concept.

7. Multidimensional Coding : Machines communicate information through human senses:

visual dimensions code includes:	auditory dimension code includes:	tactile dimension code includes:
- shape &size	- loudness	- heat
- configuration	- frequency	- pressure
- color	- interval	- texture
- portion		

Machine-user communication improves when multiple verbal and nonverbal codes are used. Thus, the user will get more out of an audiovisual presentation than out of either audio or visual alone.

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[1] Rheinfrank," A Conceptual Framework ", pp. 31-32

8. Motivation : The cause of behavior. Motivation serves two functions:

It energizes behavior.

It gives direction to that behavior.

Design should incorporate intrinsically motivating rather than the extrinsically motivating interaction.

8.1 Intrinsic motivation, the action and the goal are inherently related. The user controls both his or her actions and the consequences of those actions. The system with intrinsic motivation will give the user enthusiasm. They will be filled with the positive feeling of :

-Enjoyment in using the system.

-Ease in learning to use the original system and in acquiring knowledge of new features.

-Competence in performance of their task.

The video game or the Apple Macintosh computer offer good examples of systems which incorporate intrinsically motivated interaction.

8.2 Extrinsic motivation, the goal is either a promise of reward or a threat of punishment. These external forces determine the consequences of an action and the user's action. For example, Extrinsic Motivation is the high salary paid for the job which needs to be done on the worst human factor system.

9. Stereotypes : Fixed patterns of behavior or thought that allow a user to generate expectations about how a device will act, what things mean and the way things work. Whenever possible, designers should use intrinsic stereotypes to generate an expectation about a required action.

9.1 Intrinsic Stereotype, the response matches the intention, such as turning the steering wheel to the right in order to go right.

9.2 Arbitrary Stereotype, such as increasing the intensity or volume by turning a dial to the right. This action has no intrinsic relationship between increasing sound and the response made to attain that objective. This action has become the stereotype, though, because it has developed over several years.

These nine principles are employed to collect information so as to effectively design the user interface and, in so doing, create a good design. Good design can be defined as providing an effective information transfer for the dialog's participant so that the user will attend to information made relevant to a task or subtask. It can provide the information transfer in its complete form if it meets these three conditions :

1. The information must be noticeably distinct from its environment.
2. The user must be sensitive to and able to detect and understand that information.
3. The irrelevant information must not distract the user's attention.

DESIGN ISSUES & HYPOTHESES WHICH HAVE BEEN UTILIZED TO IMPROVE USER INTERFACE.

Among the number of design issues and hypotheses which have been utilized to improve user interface, three major concepts are assumed in designing user interface into Port-A-Map :
1. The processes used in the support of information exchange.
2. The idea of gradual growth.
3. Direct manipulate.

These concepts and samples of interface design issues are described, as followed :

1. THE PROCESSES USED IN THE SUPPORT OF INFORMATION EXCHANGE :

The processes involved in the support of information exchange between user and computer focus on :

The design of command languages
The wording of system Messages
- On-line Tutorials explanations and messages
Response time and Display rates
- Hardware devices
Natural Language is not suitable for this tool

1.1 The Design of Command Language (Menu Selection is preferred)

When working on a computer, users need to be able to instruct the machine about their requirements and, in order to do so, need some form of a "Language". This special purpose language is provided in two types : The command language and the menu selection.

The command language and the menu selection approaches are distinguished by the demands they place on the user.

The command language	The menu selection
- Command language requires users to memorize the options and to formulate possibly complex requests.	-The list of options in menu selections eliminates the need for memorization, and provides the operator with a clear indication of permissible actions.
- Infrequent or novice users may find it difficult to maintain the permissible syntax in their memory, and it is difficult for designers to provide specific error messages when problems arise	- Well-written menus offer novice users familiar terminology and a step-by-step process for retrieving information or specifying procedures.
- Knowledgeable and frequent users prefer command languages because, in many cases, they permit faster task completion.	- With menus systems, user might be annoyed if he must wait for lengthy menus. In this case, users should be able to enter their choice before the menu is completely displayed and short cuts should be permitted for knowledgeable users.One appealing strategy is to number the menu choices but provide alphanumeric names for each menu or picking mechanism like mouse, allowing knowledgeable users to immediately specify the target menu.
There are important features for expert users who prefer to define their own commands, and personalize their environment by encapsulating frequently used command sequences in a new command.	- The character of the menu selection hasn't offered this feature yet.

1.2 Wording of System Messages

The negative image that computer systems generate in many people is largely due to the difficulties they have when they make mistakes or when they are unclear about what to do next.[1] System messages such as "FATAL ERROR, RUN ABORTED," or obscure codes such as "0C7", make users confused, dismayed and discouraged from continuing.

Besides these error messages, there are many kinds of messages that should come under close scrutiny during the design process : menu selection choices, prompts for command language or data entry, feedback indicating task completion, results from database searches, and explanatory or tutorial information.There have been efforts made to lesson the impact of these negative messages. Suggested improvements are, as follows:

- Use Positive Tone indicating what must be done, rather than condemning the user for the error. Instead of "Illegal" or "Error", try "Your password did not match the stored password. Please try again".

- Be specific and choose terminology from the user's problem domain. Instead of "Invalid Data" in an inventory application, try "City street No. range from 1 to 15"

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[1]Shneiderman," The Future of Interactive System and Direct Manipulation," p.6

Place the user in control of the situation, and provide enough information for user to take action. Instead of "Incorrect Command," try "Permissible commands are : Save, Load, or Explain."

Provide a neat, consistent, and comprehensible format. Avoid lengthy numeric codes or obscure numeric and cluttered displays.[1]

1.3 On-line Tutorial, Explanations, and Messages

As computer use shifts from the expert to the novice and to the knowledgeable user, the need for on-line aids increases. There is a certain school of thought which advocates providing sufficient tutorial and reference material on-line so that printed manuals are unnecessary. This idea has merit since the on-line material can focus on the current user's task, can be updated regularly, may be less difficult to locate, and avoids the cost and delay of printing and shipping.

However, the on-line aids also have disadvantages. Experiments show that having a printed manual in hand while looking at a computer display is useful, because the problematic terminology or task remains visible while the explanation is read. Many users of on-line aid facilities have to make lengthy written notes about proper command forms before returning to the task.

Finally, an effective strategy with screen display is to have a 4 or 6 line window, so that helpful instructions can be presented while the task remains visible. A more ambitious alternative is to have a second screen for helpful information. Also, screen format should be uniform and orderly, so that users will know where to look for specific information and can use positional cues when scanning for previously retrieved information.

1.4 Response Time and Display Rates

The speed of an interactive computer system is a function of response time, the number of seconds from the time the operator sends a command until the system begins displaying a response, and display rate, the speed with which characters or graphics appear on a screen or hard copy device.

An appropriate set of guidelines might be:

a) Typing and cursor motion commands should generate results in 0.1 seconds.

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[1]Shneiderman," The Future of Interactive System and Direct Manipulation," p.6

b) Frequent simple commands should take less than a second. Other commands may take longer, but the response time for similar commands should have a small range,say 20 % deviation from the mean.

c) As the response time shortens, users pick up the pace of interaction and may make hasty decisions or learn improperly. Faster is not always better, especially for novice users who may prefer slower operation.

1.5 Hardware Devices

In the first place, the hundreds of variations in basic items, such as keyboards, screens, and hard copy printers, must be reviewed for suitability. Then, the numerous additional devices such as light pens, touch screens, graphic tablets, joysticks, programmed function keys, and rotating knobs would be considered later.

However, since new devices are appearing on the market regularly, and since system portability is often important, a modular approach which avoids dependence on a specific system is appropriate. Folley and Wallace (1974) describe four logical device types which might be the basis for design :

a) pick : a mechanism for picking from a set of displayed entities.

b) valuator : a device for setting numeric values, e.g. a rotation knob with a potentiometer, or keyboard entry of the value.

c) locator : a way of specifying a position in 2 or 3 spaces,e.g. a touch screen, graphics tablet or arrow keys.

d) button : a selection device for initiating or terminating action.[1]

By designing a device in an independent manner, new approaches or hardware can be easily incorporated. Some designers are tempted to include novel devices, but fail to realize their addition complexity. Novel devices are attractive to users but the interest wears off quickly unless the device is a genuine improvement. Also, when designing with multiple devices, a designer should limit the number of context shifts necessary.

1.6 Natural Communication is not suitable for this tool

It seems reasonable for the user to ask for computers which are like them -human.

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[1]Shneiderman, " The Future of Interactive System and Direct Manipulation," p.8

There are several developments of natural language computing which strive to find the natural solution to the user communication problem; none of them, however, are practical. Some of them are already very powerful, and some computers are capable of displaying very high levels of natural language comprehension (e.g. Schank and Abelson, 1977; Lehnert,1978.)[1] However, there are many problems, both practical and theoretical, to using such systems for routine application. The main practical problem is that such systems are of necessity very large and slow.

There is a good approximation to natural language which might be achieved. One strong argument states that where precision is required, plain language would often serve us less well than a formal language.[2] But some problems still exist; the fact that a computer accepts an input does not mean that it "understood it" in the way that a user meant it. Nor may its reply mean what a user thinks it means, should any discrepancy in assumptions exist.

Therefore, achieving "natural" communication is not just a matter of providing tolerant and familiar syntax. The freedom to use linguistic construction appropriate to the task is equally important. These efforts toward designing a natural language do not seem to be advantageous in that the software designer ignores the "action" orientation of natural language. So, when comparing natural language to the five methods from the beginning of the chapter, a combination of these methods which give more interpretation on display may provide a more obscure system message to the naive user.

2. THE IDEA OF GRADUAL GROWTH

One approach is to design such a system with levels adjusted to users with different degrees of experience.

Let us assume that a computer package is going to be used by many people. Many of them are inexperienced with computers. They need an interface, in which the computer guides them along with carefully worded questions, where they only have to answer the question from the computer. Such an interface is simple for beginners to use, because the computer tells them what to type. But the users who have used the package for a long time and have other computer

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[1]M.E. Sime and M.J. Coombs, Designing for Human - Computer Communication, (New York : Academic Press, 1983),p.9

[2]Ibid., p.10

experience may feel that it takes too much time to get things done, and that their freedom is restricted. They want an interface in which they can get the computer to do what they want with short simple commands. They want the freedom to decide what to do with as few arbitrary restrictions as possible.

Rather than two different systems, one for the novice and one for the experienced user, the ideal system should perhaps be both at the same time. The guidlines for the idea of gradual growth are as follows:

a) The user can move toward the advanced level in small steps, all the time feeling secure with the system before taking the next step.

b) Depending on the needs of one user, the system can be advanced where this user needs it, and simple in those areas in which this user does not feel is worth learning advanced ways of usage.

c) The novice and the advanced system user employ the same basic routines which save programming effort, ensure consistency after updates, and mean that as much as possible it will work and look alike to both the novice and advanced user.

The five information exchange processes indicated above are also concerned with this idea, but their practical methods are still laden with problems, such as the on-line tutorial. Just because on-line aids are available does not ensure that they are effective. Too often, informally written screens attempt to serve all levels of users and confuse novices with complex terminology or annoy experts with lengthy tutorials. A well-designed on-line aid should provide separate tutorials for novices, command explanation for knowledgeable intermittent users, and brief messages about specific problematic situations.

3. DIRECT MANIPULATION

Upon interviewing the interaction system's user for the system which satisfied them, the most, the result revealed to the system group that its principle was to generate a glowing enthusiasm among users. These enthusiastic users are pleased by the system and enjoy using the system because of the ease of learning and use of the system.

So, the model of features which produced the same delight was developed, called Direct Manipulation. Its central ideas seemed to be visibility of the object of interest, rapid reversible actions, and replacement of complex command language syntax by direct manipulation of the object of interest. Examples of Direct Manipulation :

a) Display Editors: This type of editor provides the full display of a page of text and, in effect, replaces the line-oriented text editors. Because of the ease of use, shorter training time and fast performance, this quality is available in most of the word processing program nowadays. The advance display editor includes :

- cursor action,visible to users such as blinking box screen.
- cursor motion device, such as mouse, joystick, graphic tablet.

b) Visicalc: This type can be called an "instantly calculating electronic worksheet" which permits computation and display of results across 254 rows and 63 columns. The worksheet can be programmed so that column 4 displays the sum of columns 1 through 3. Thus, every time a value in the first three columns changes, the fourth column changes as well.

c) Spatial Data Management: This example can be explained as follows ;

In one scenario, an icon representing different aspects of a corporation, such as personnel, an organizational chart and travel information, are shown on a screen. By moving the joystick and zooming in on objects of interest, the user is taken through complex "information spaces" or "I-spaces" to locate the item of interest. A building floor plan showing departments might be shown and, when a department is chosen, an individual office would become visible. On moving the cursor into a room, details of it would appear on the screen. If the user chooses the wrong room, he merely backs out and tries another. The lost effort is minimal and there is no stigma of error.

d) Video Games: Maybe the most exciting, well-engineered and certainly successful application of the direct manipulated concept is in the world of video games. These games provide a field of action which is simple to understand since it is an abstraction of reality. Learning is by analogy.

Watching a knowledgeable player for several minutes is sufficient to learn the basic principles.

The commands are physical action such as button press, joystick, knob rotation.

There is no syntax to remember and therefore no syntax error message. If users move the spaceships too far left, then they merely move back to the right (wrap around). This result of action is obvious and can be easily reversed.

These principles can be applied to office automation or other interactive environments. In non-game designs, predictable system behavior is preferred.

e) Computer Aided Design / Manufacturing: Many computer aided design systems for automobiles, electronic circuitry, architecture, aircraft or newspaper layout, use principles of direct manipulation. For instance, the operator may see a circuit schematic on the screen and, with lightpen touches, can move resistor or capacitors into or out of the proposed circuit. When the design is complete, the computer can provide information about current, voltage drops, fabrication costs, or warning about inconsistencies and manufacturing problems. Similarly, newspaper layout artists or automobile body designers can easily try multiple designs in minutes and record promising approaches until a better one is found.

f) Further Example of Direct Manipulation: The trick in creating a direct manipulation system is to come up with an appropriate physical model of reality. For example if the application is a personal or business address listing , then a display of a "Rolodex - like" device seems natural. More examples are :

Driving an automobile : The scene is directly visible through the front window and action such as braking or steering have become common knowledge in our culture. To turn to the left, simply rotate the steering wheel to the left. The response is immediate and the scene changes, providing feedback to refine the turn.

Industrial Robot Tools : The operator holds the robot "hand" and guides it through a spray painting or welding task while the controlling computer records every action. The control computer can then operate the robot automatically and repeat the precise action whenever necessary

All of these direct manipulation examples demonstrate the capability of designers, their innovative inspiration and their intuitive grasp of what users would want. From the examples given above, an integrated portrait of direct manipulation can be constructed as follows :

1. Continuous representation of the object of interest.

2. Physical actions or labelled button presses instead of complex syntax.

(Dealing with representations of objects may be more "Natural" and close to innate human capabilities; this might be because action and visual skill emerged far before language in human evolution. Psychologists have long known that spatial relationships and action are more quickly grasped with visual rather than linguistic representation.)[1]

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[1] Shneiderman,"The Future of Interactive System and Direct Manipulation", p.22

3. Rapid incremental reversible operations whose impact on the object of interest is immediately visible.

(This is the success of Direct Manipulation that shows the understanding in the context of syntactic/ semantic mode, which are considered as cognitive models of user behavior.

-Semantic knowledge which is acquired through general explanation, analogy and example, is easily anchored to familiar concepts and is therefore stable in memory. This knowledge is largely system independent.

- Syntactic knowledge is the knowledge of command syntax. It is volatile in memory and easily forgotten unless frequently used. This knowledge is system dependent.

Novices begin with a close linkage between syntax and semantics; for them, the command syntax is the focus of their attention as they seek to remember the command function and syntax. As they gain experience, they increasingly think in higher level semantic terms which are freer from syntactic detail. Novices may have a hard time figuring out how to move a sentence of text, even if they understand each of the commands. Novices using editors which have a "change/ old string/ new string/" command must still be taught how to use this command to delete a word or insert a word in a line.

The Direct Manipulate helps this difficulty by making the object of interest visible. When the object of interest is displayed so that actions are directly in the problem domain, there is little need for the decomposition into multiple commands with a complex syntactic form.)[1]

When considering the benefits received from the direct manipulation concept, it is revealed that they are similar to the results shown to the nine principles of Designing User-Device Interaction. Direct Manipulate collects the practical design issues for :

-The Man-Machine Communication

- Mapping the interaction in the user mind

- Idea of gradual growth

- Intrinsic Motivation

- Multidimensional Coding

Intrinsic Sterotype.

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[1]Shneiderman,"The Future of Interactive System and Direct Manipulation", p.22

CHAPTER VI

DESIGN ANALYSIS

Nowadays, everyday trips change their courses to move along a well - marked system of streets, highways, trails and railways. Even though there are a number of things available for direction finding, the problem of losing your way is still common.

Today, losing direction is not the same as before. People get lost among the webs of highways, caused by their confusion from road signs, maps, or any device they use. And most of the time it happens because of the drivers ' constraints in moving along with modern traffic which uses most of their attention. They can't process the direction information prepared by those devices in time, so they lose their way.

Chapter V discussed the user, the computer, and the environment. These will be used in analyzing the design development of the direction finding device. The following are performed by the task analysis method :

1. Determine demand & capability
2. Determine limiting subsystem
3. Alter Task / Operator / Machine / Environment to remove or reduce limitation.

1. Determine Demand VS. Capability :

Task Demand.	Requirements operator must meet for successful task.	Capability : compare with information on human factors, how man can do this task
- lost the way and need to get back - plan the trip	- know his location - know his destination - be able to track the route between those two places.	- human has no orientation ability. Only by experience or learning how to use direction finding tool , man is able to move along his desired route.
- getting around	- know the location of places - know the direction to and around those places (area map)	
- move faster	- process the above information faster	- Human has limited speed of processing information. However, the problem can be overcome if automated systems are brought in to asist.

2. **Determine Limiting Subsystem :** in order to find which aspects of task performance are limited so effort can be concentrated on this aspect.

a) Task		
limit to	- perform without car	i.e. finding direction or planning trip while walking , using airlines , or staying in hotel
	- perform with car	i.e. finding direction or planning trip while driving.
b) Operator		
limit to	major user - business traveler other user - pleasure traveler	
c) Machine		
limit to	automated navigation system	
d) Environment		
limit to	the modern traffic environment of - city street intercity highway.	

3. **Alter Task / Operator / Machine / Environment To Remove or Reduce Limitation on the Concentrated Aspect :** A human factors understanding can help adjust machine or environment. In this design, the objective is to develop the tool (machine) to be used in the modern traffic environment. Analysis of man - machine interface model of two groups of travelers (travelers without car and travelers with car) , along the three priority steps is described.

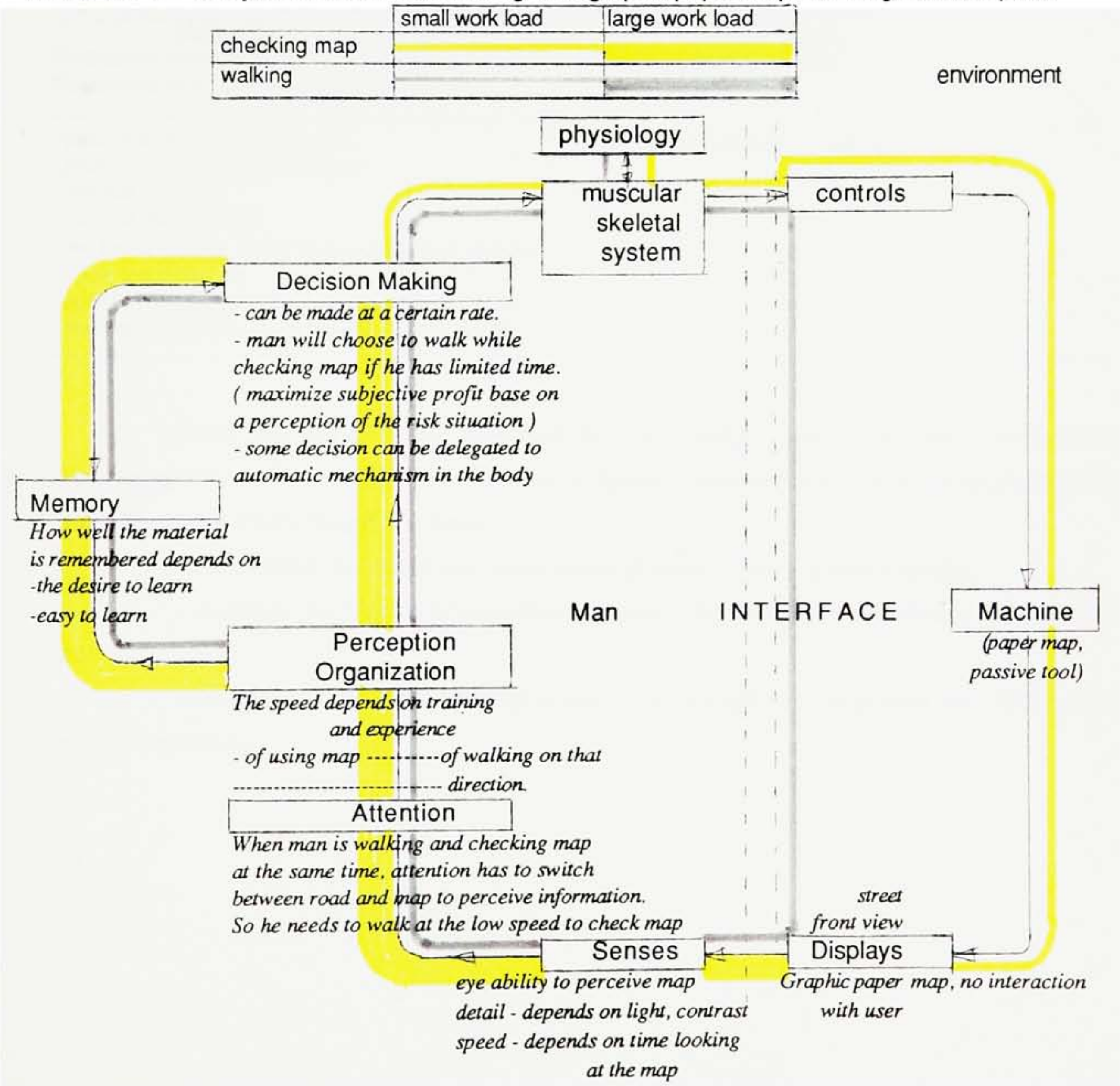
a) Analysis model of man walking / driving with graphic paper map and / or magnetic compass.

b) Alter Task / Operator / Machine / Environment as the automated system is brought into the model.

c) Adjust the model with the Human Computer Interface concept, to help improve the design definition to meet traveler satisfaction.

3.1. TRAVELER WITHOUT CAR :

Model 3.1- a : Analysis model of man walking with graphic paper map and magnetic compass.



In this model, man carries the whole work load on either the perception process or physical activity in order to go on the desired direction.

The tasks of man and device in model 3.1- A can be summarized as follows :

Man Perception information & Processing information- Mechanical work on map and walking activity:	Device Graphic Paper Map:
- perceive information by eyes. - process information in order to find the location, find the destination, set those places along the sequence of events, know the direction. - control the body to move in the right direction, maintain the body along the pavement, street.	(passive tool, no action)

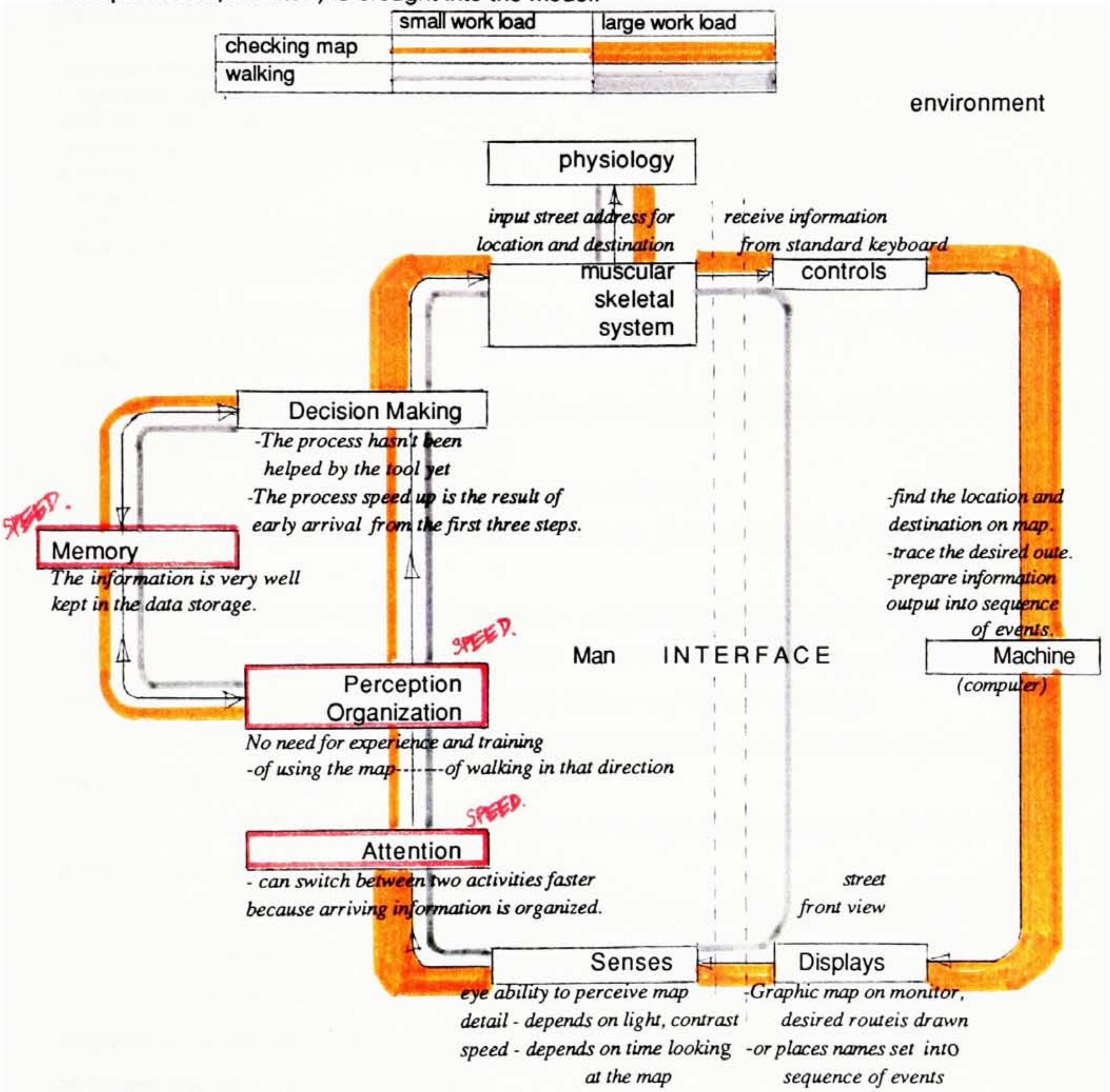
From the model 3.1-a , because of " the speed / error trade off " mechanism in processing information process, any increase in speed is brought at the expense of an increase in error. To improve both speed and errors :

- the number of alternatives need to be cut down, that is, simplify the job,

increase the rate of processing information by training or ergonomic redesign of the tool.

In order to do this, the automated system is brought in to help alter the model of man machine interface.

Model 3.1-b: Alter Task / Operator / Machine / Environment as the automated system (keyboard, microprocesser, monitor) is brought into the model.



In this model, man has less work load compared with his work load on model 3.1-A.

The task of man and device in model 3.1 - B is summarized as follows :

Man	Device
Perception information & Processing information- Mechanical work on :	The computerized portable map (keyboard, microprocesser, monitor)
- perceive information by eyes. (The device organized the map information and gave the desired direction to man) - process the organized information by passing it through steps with speed. - decision making - control the body to move in the right direction, maintain the body along the pavement, street.	- receive information input through keyboard. -process information in order to find the location on map, find the destination on map, know the direction. -send outputs in form of the sequence of events, either map graphic or words.

In order to develop the model 3.1 B. by involving "Human Computer Interface Design", considerations are :

Concentrate on designing control switch and display of the device, because they are channels exchanging information with man.

Direct manipulation enters into design as follows:

a. To support information exchange - use the menu selection, with scroll and pick system by switch button.

b. Bring in the idea of gradual growth - programmer will work on setting the information on screen to guide user with carefully worded questions including setting the steps of trip in sequence. The information should satisfy both novice and experienced user.

Designer will design minimized switch control that works well with either information on the display or human hand.

c. Intrinsic Stereotype - display map is heading up presentation, the direction on screen is the view up front.

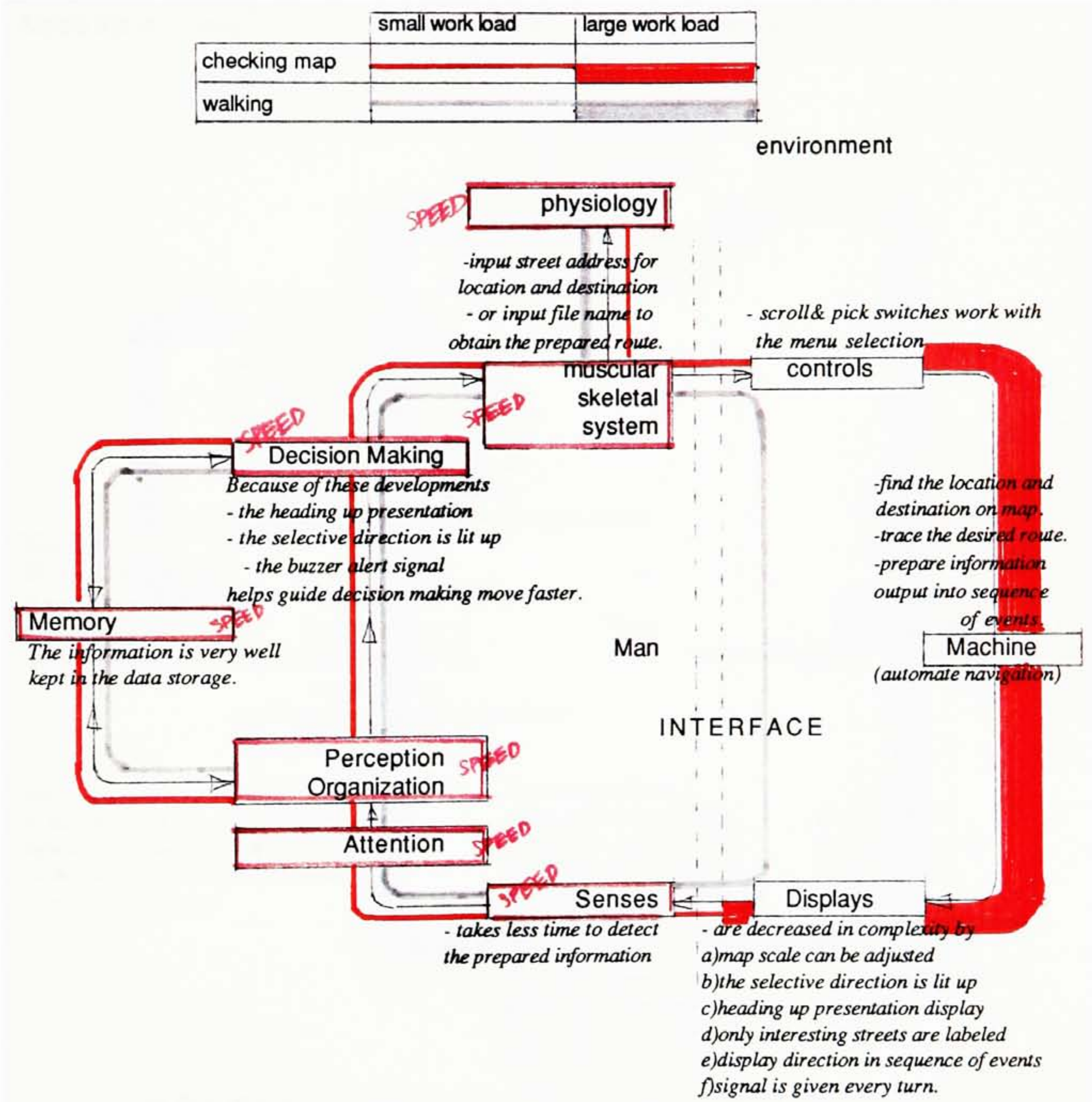
- display the sequence of events ; graphic map type uses arrows to indicate direction , character type will set place names in column order.

d. Multidimensional coding include auditory coding, the buzzer , for alert system (the magnetic compass will be able to detect any change of body axis that is different from the direction on screen and alert user to check map.

e. Intrinsic Motivation - user will be satisfied with the ease of the device.

- convenient to carry as a portable or bring into car to use as car navigation.

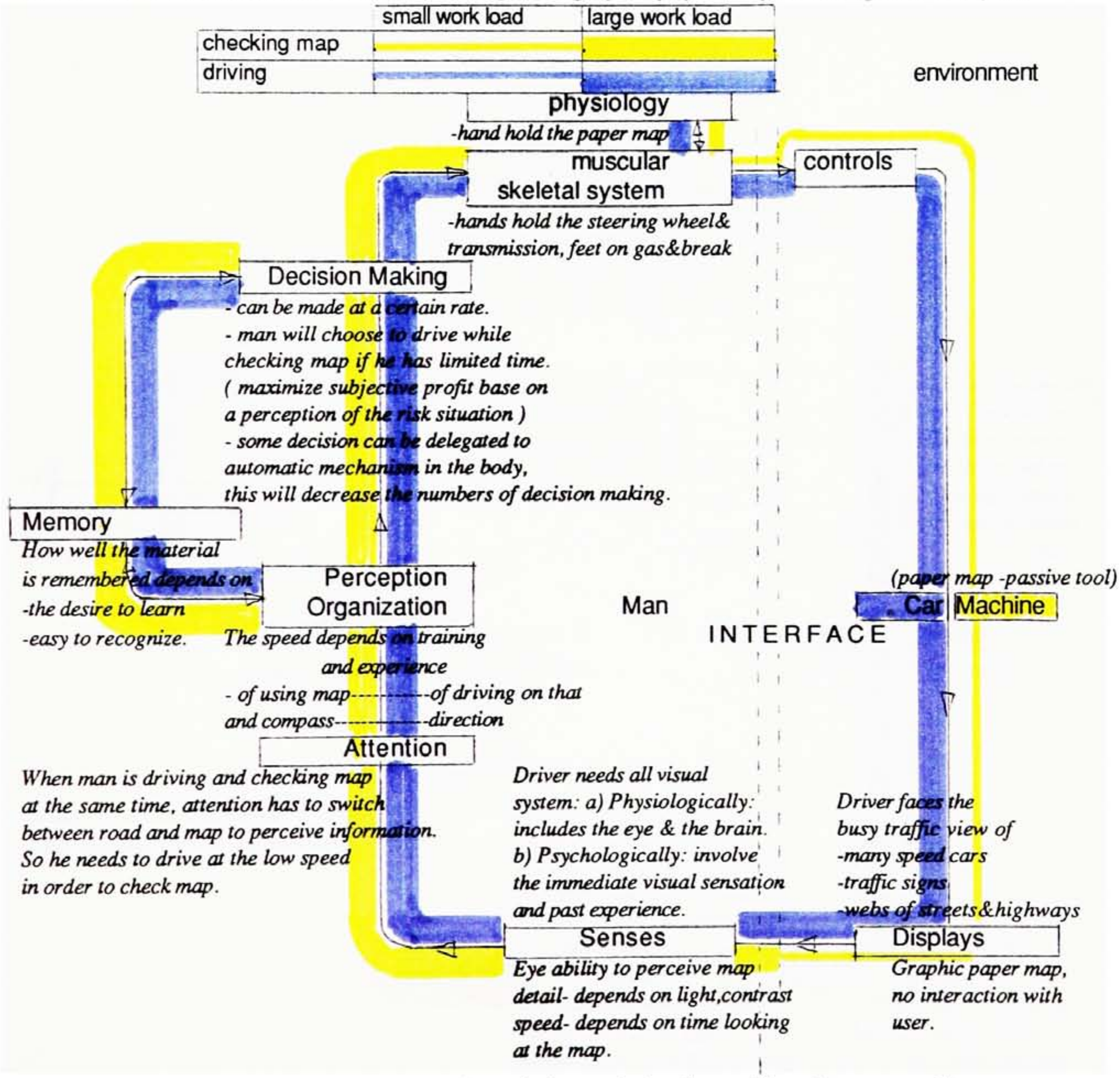
Model 3.1 -c : Develop the model 3.1 -b by involving " Human Computer Interface " design



In this model, the tool does almost all of the perception process , therefore one can move faster with easier access than the last model.

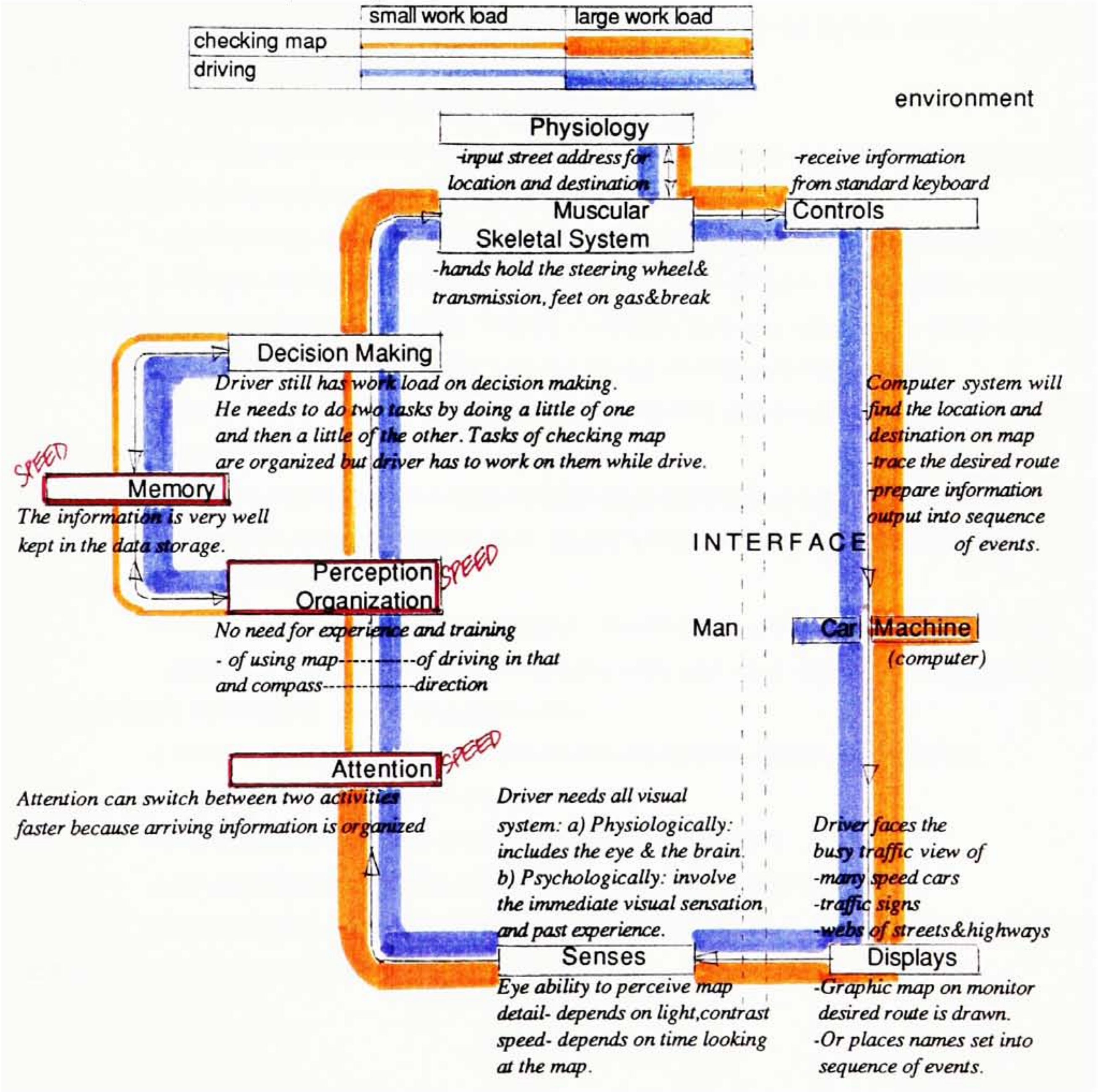
3.2. TRAVELER WITH CAR :

Model 3.2- a : Analysis model of user driving with graphic paper map and magnetic compass.



In this model, one carries the whole work load on either the perception process or physical activity for driving and checking the map, in order to move in the desired direction.

Model 3.2-b: Alter Task / Operator / Machine / Environment as the automated system (keyboard, microprocessor, monitor) is brought into the model.



In this model, one has less work load compared with the work load on model 3.2-A.

In order to develop the model 3.2 B. by involving " Human Computer Interface Design " the considerations are :

Concentrate on designing control switch and display of the device, because they are channels exchanging information with the user.

The Direct Manipulation is put into design as follows:

a. To support information exchange - add the strip display as the route turning signal. Driver will receive information in a short time without processing it.

- use the menu selection, with scroll and pick system by switch button for route planning.

b. Bring in the Idea of Gradual Growth - programmer will work on setting the information on screen to guide user with carefully worded questions including setting the steps of trip in sequence. The information should satisfy both the novice and the experienced user.

Designer will design minimized switch control that works well with information on the display and human hand, for either portable or car use.

c. Intrinsic Stereotype - the route turning signal will flash the turning lamp on the left side or right side of screen to indicate the next turn. Street names, both the current street and the next one, are shown on screen.

- display map is heading up presentation, the direction on screen is the view up front.

- display the sequence of events ; graphic map type uses arrows to indicate direction, character type will set place names in column order.

d. Multidimensional coding - the combination of acoustic signals and visual aid

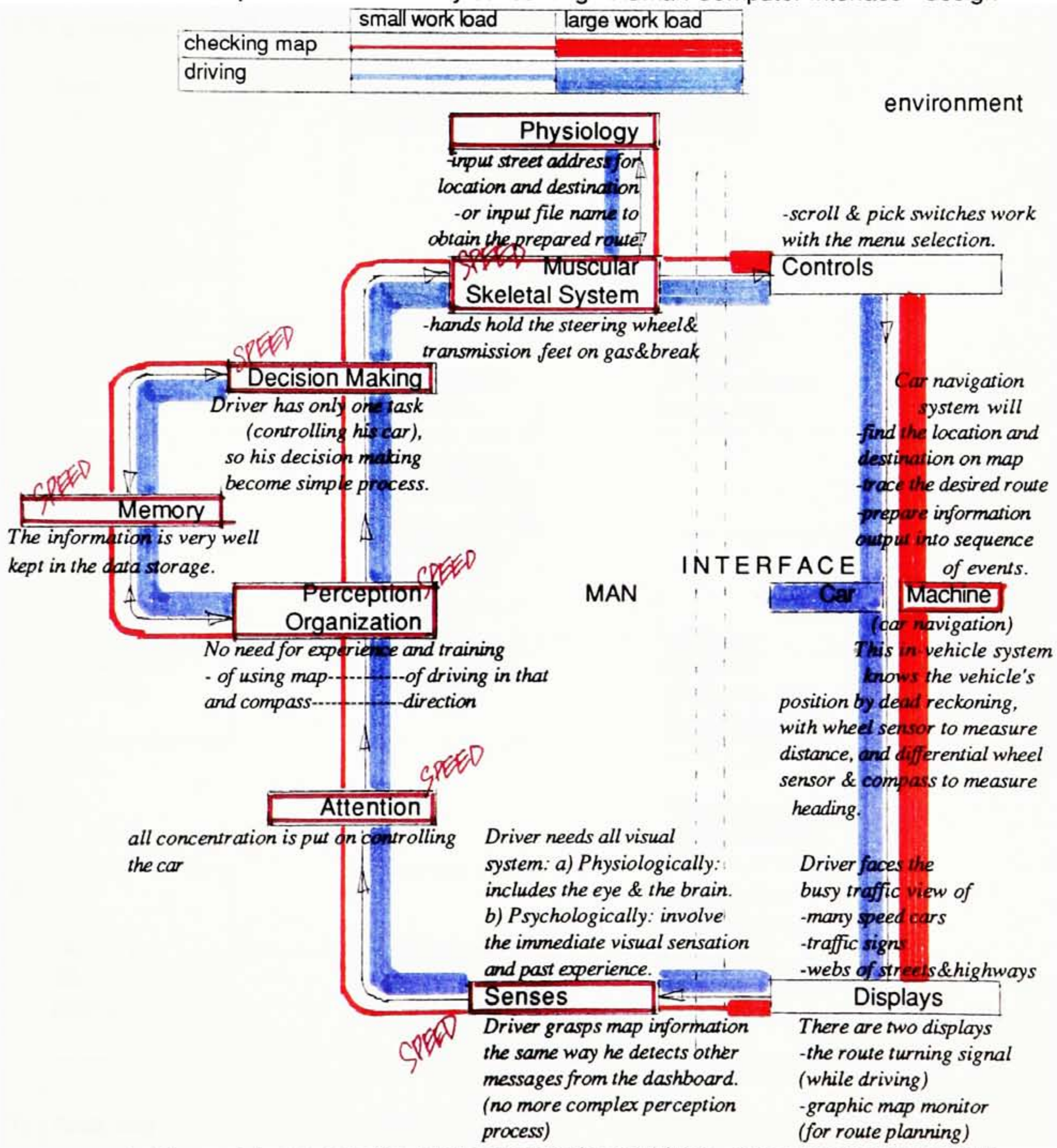
- the beep signal alert for the next turn

- the flashing lamp for that turn light up the next street name.

e. Intrinsic Motivation - user will be satisfied with the ease of the device.

car navigation allows driver to have full control of his car, so he can drive safely and get to the destination in a shorter time.

Model 3.2 -c : Develop the model 3.2 -b by concerning " Human Computer Interface " design



In this model, one can give total concentration to driving , car navigation does all the work in tracing the route.

3.3 ANALYSIS OF THE DEVICE FEATURE BY ENVIRONMENT

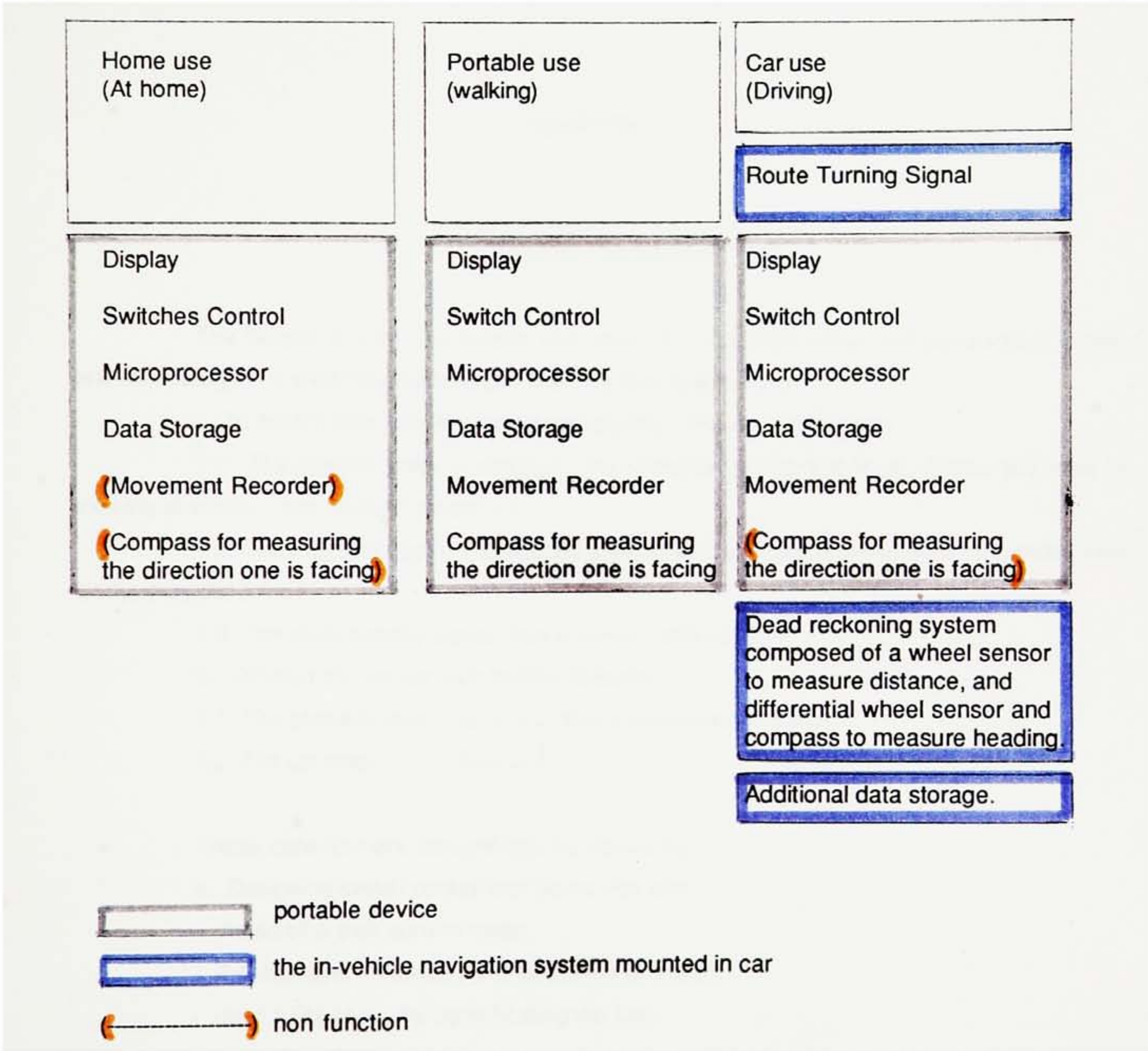
3.3- a. Analysis of uses in three environments : home use, portable use, and car use.

	Home use (At home)	Portable use (Walking)	Car use (Driving)
1)	Study map & plan trip		
2)	Plan trip for use when	(Walking) Use the prepared map for walking	(Driving) Use the prepared map for driving
3)		Plan the route Use for walking	
4)	(At home) Study map plan trip	Plan the route or record the walking trip for use when or for the next walking trip	(Driving) Use the prepared map for driving
5)			Plan the route Use for driving
6)	(At home) Study map & plan trip	(Walking) Use the recorded route for walking	Record the driving trip for use when or for the next driving trip
7)	Area Map	Area Map	Area Map

3.3-b Components of the device needed for each use:

Home use (At home)	Portable use (walking)	Car use (Driving)
		Route Turning Signal
Display	Display	Display
Switches Control	Switch Control	Switch Control
Microprocessor	Microprocessor	Microprocessor
Data Storage	Data Storage	Data Storage
	Movement Recorder	Movement Recorder
	Compass for measuring the direction one is facing	Dead reckoning system composed of a wheel sensor to measure distance, and differential wheel sensor & compass to measure heading.
		Additional data storage.

3.3 -c Analysis components of a device which has three uses :



CHAPTER VII

DESIGN DEFINITION

The Device is a tool for people who travel, to help them follow directions easily, faster, and with safety. The major concepts drawn from the final analysis are :

1. To tell the direction in sequence of events. This can be done by

1.1 The graphic map on monitor - the selective direction is lit up, arrows are used to indicate direction .(see analysis model 3.1-c)

1.2 The character type - this second selection will set place names in column order. (see analysis model 3.1-c)

1.3 The route turning signal. (see analysis model 3.2-c)

2. Offering the device with flexible features:

2.1 The portable map. (see analysis model 3.3-c)

2.2 The car map.

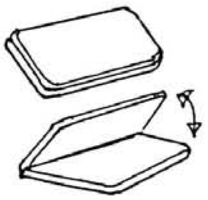
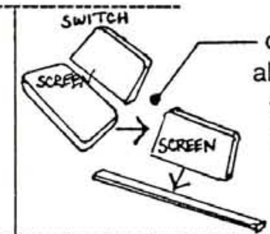
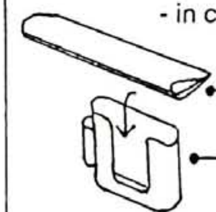
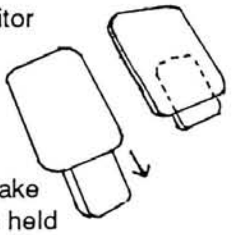
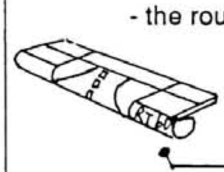
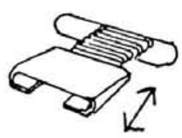
These concepts are brought into the device by :

a. Designing switch control that works well with
the scroll & pick system menu
the displayed information in sequence of events
user 's finger on the hand holding the tool
user who drives.

b. Designing the structure, form, color, and graphics of the device support its function.
(The tool 's structure is construced by its flexible function in model 3.3 -c.)

CHAPTER . VIII

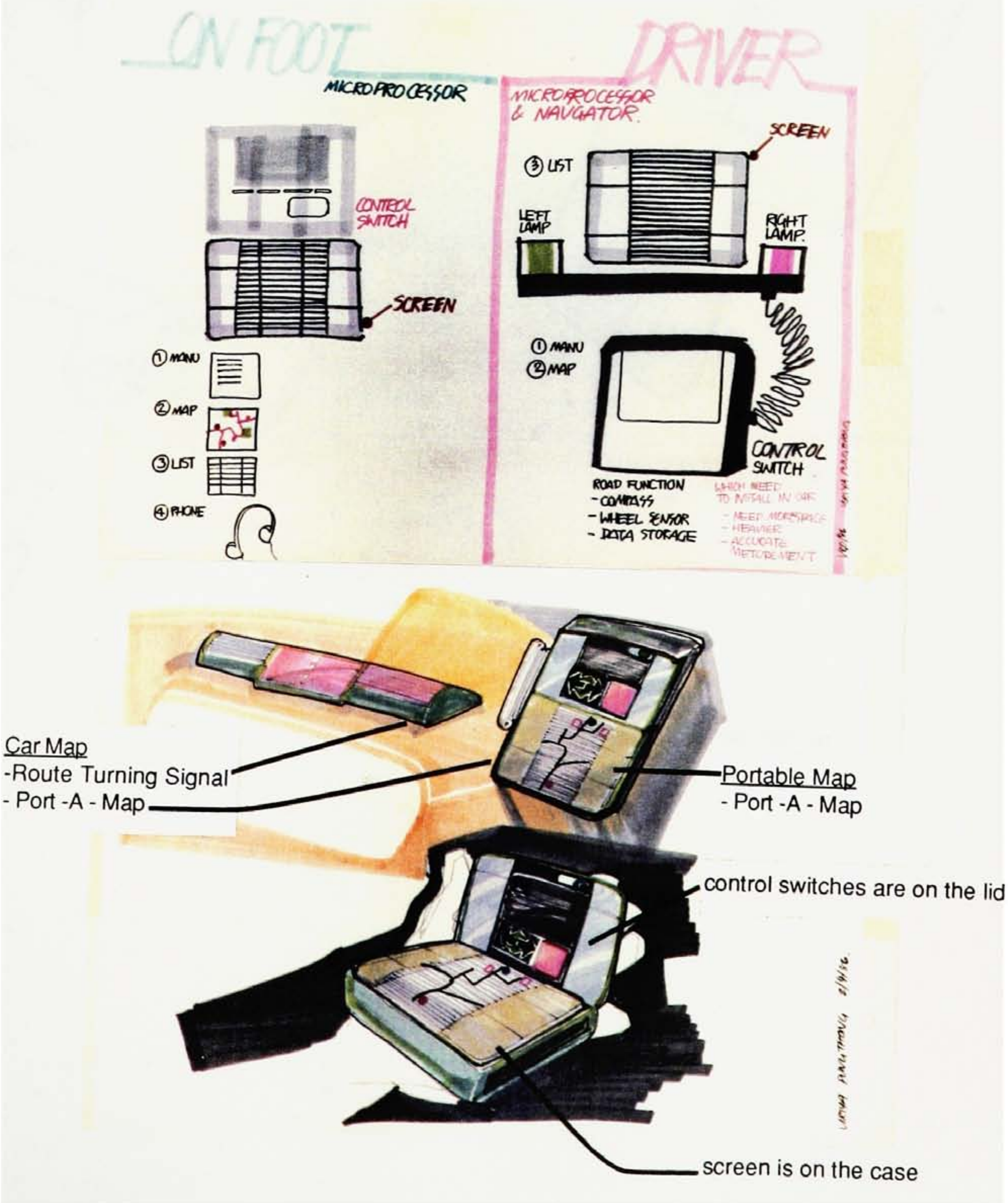
DESIGN DEVELOPMENT

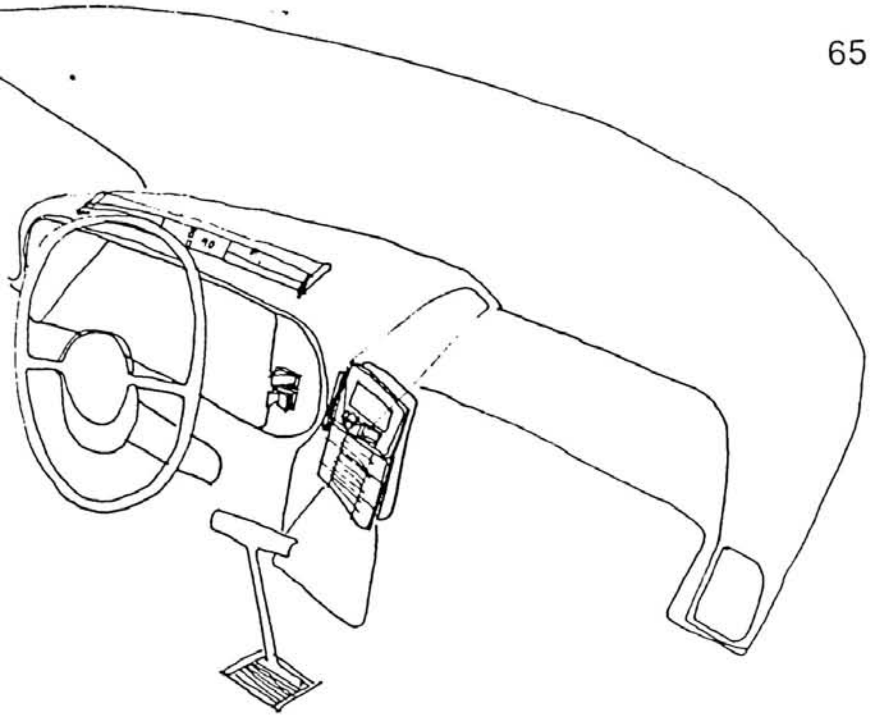
portable			car use	
- screen tells the sequence of events by place names & map graphic. - rectangular flat case with lid cover.		COMBINATION 1		display of portable map also works as the display for car navigation when bringing the device to use in car.
- single piece hand tool with no lid cover		COMBINATION 2		- in car, the sequence of events are developed into the route turning signal additional piece is the socket to hold the single piece hand tool (display of Port-A-Map also shows graphic map for car)
- single piece monitor with the slide-in handle - this style helps make the tool easy to be held & move finger on switches with one hand		COMBINATION 3 " FINAL DESIGN "	 	- the route turning signal provides two types of signals: light signal & beep signal plus street name appears here at every turn - the socket is developed as it will automatically slide back into its slot inside dashboard when it is not in use.

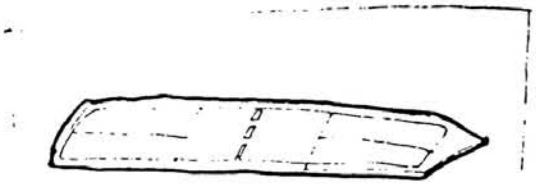
Details of each combination are as follows :

COMBINATION 1

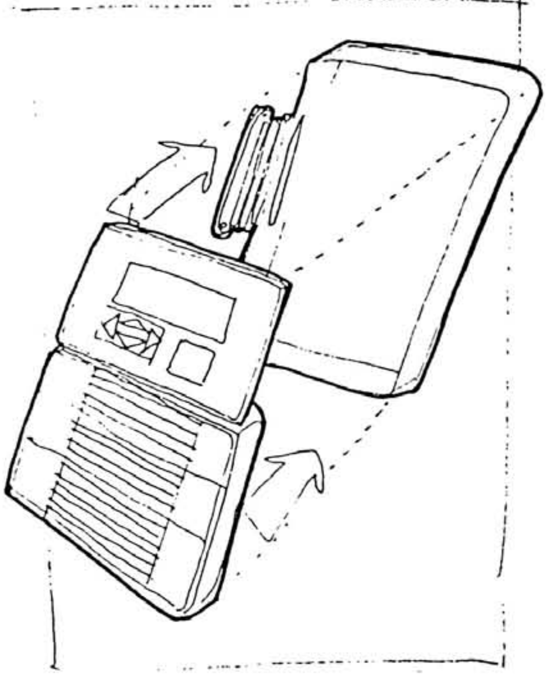
- Rectangular flat case
-Open Up Lid Style, which has the control switches & screen inside.



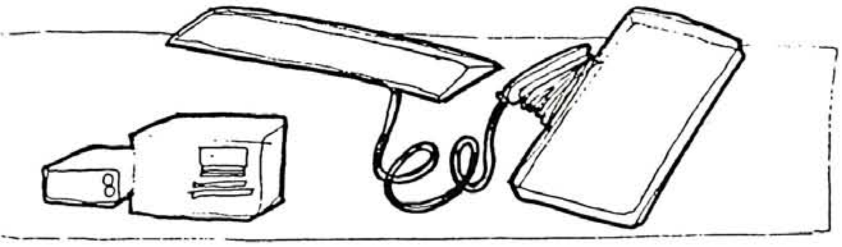


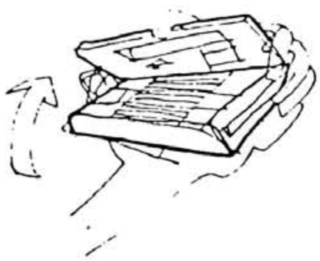


Route Turning Signal



Graphic Map Display
for car



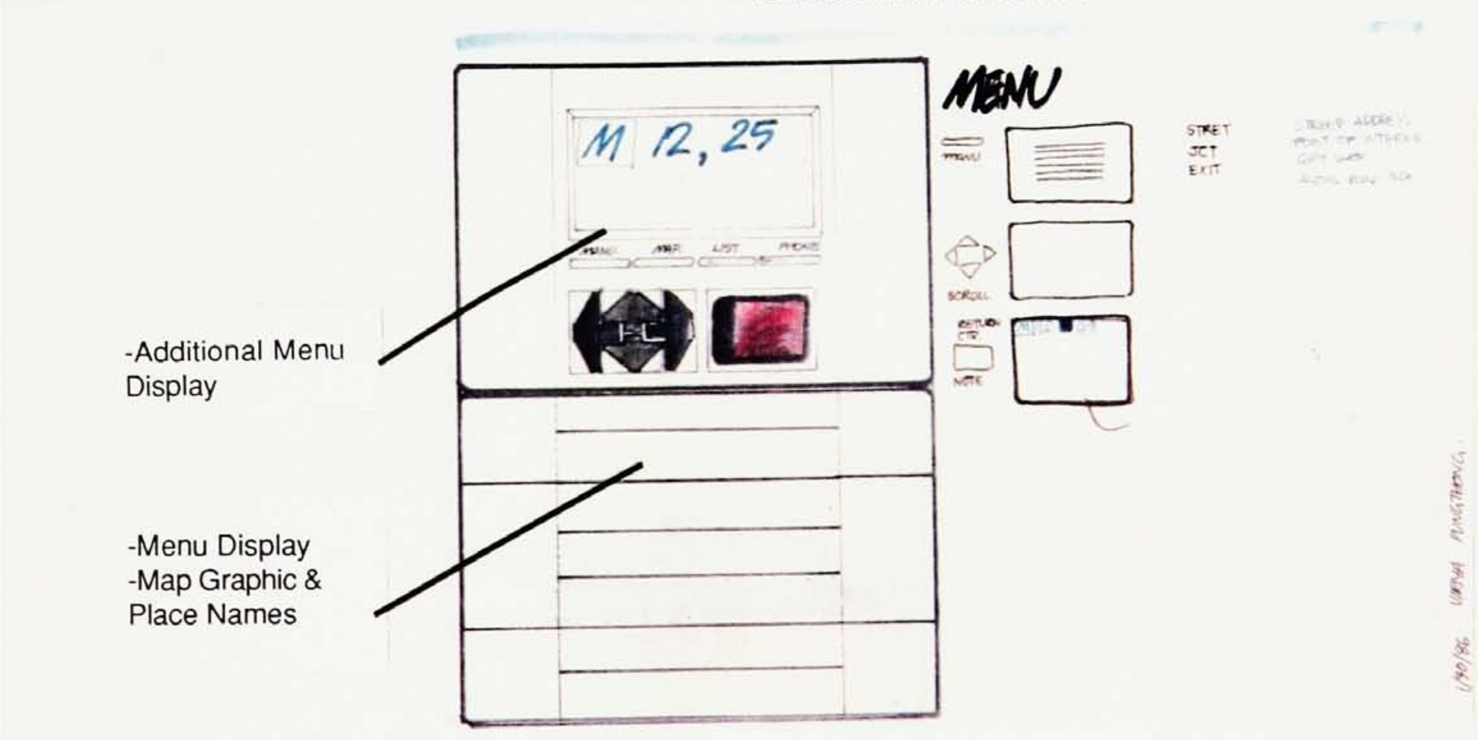


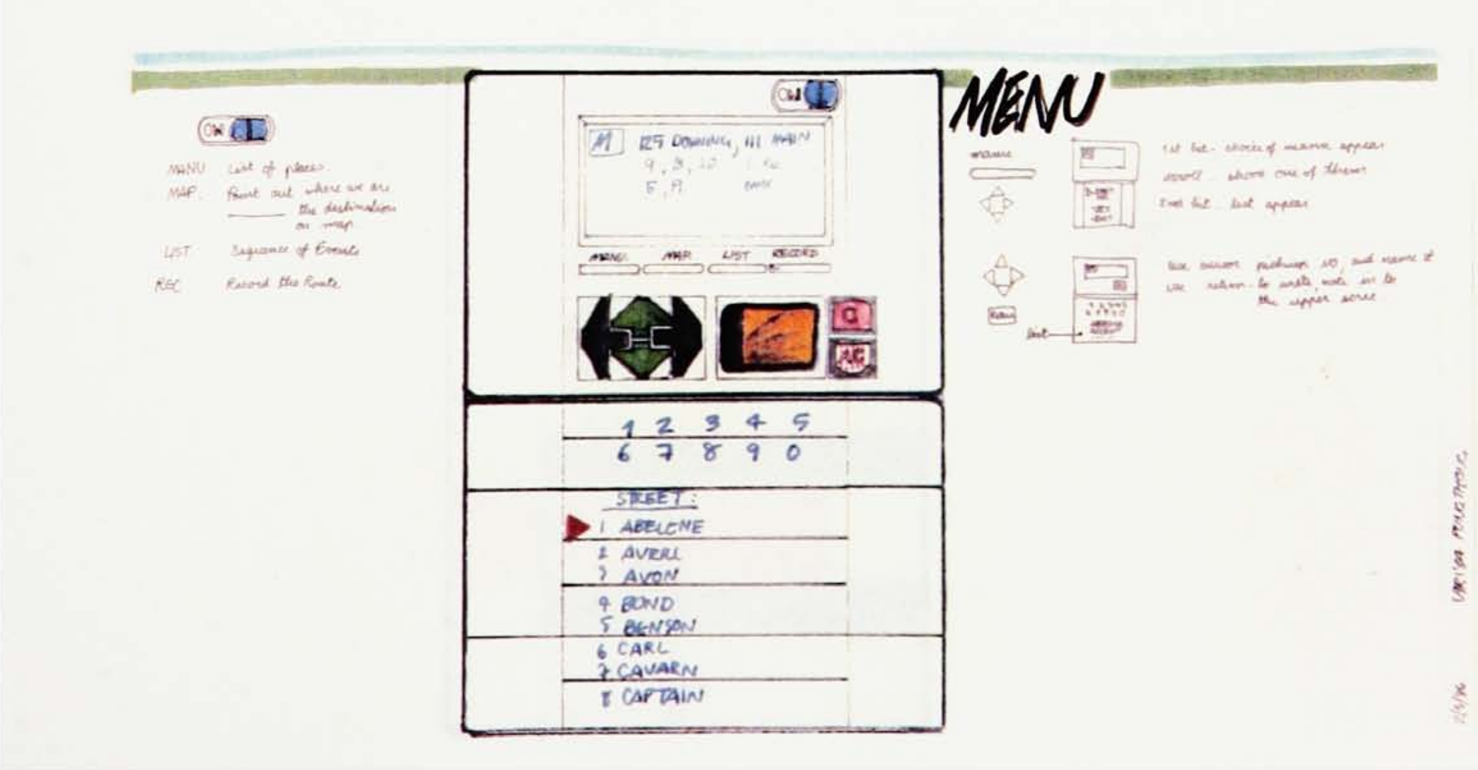
Bring portable map used with car

VIRIYA PUNGTHONG 2/4/86.

Set the sequence of actions
in finding direction into four steps,
in order to develop switches &screen.

1) MENU Planning route by picking street address
for location & destination.

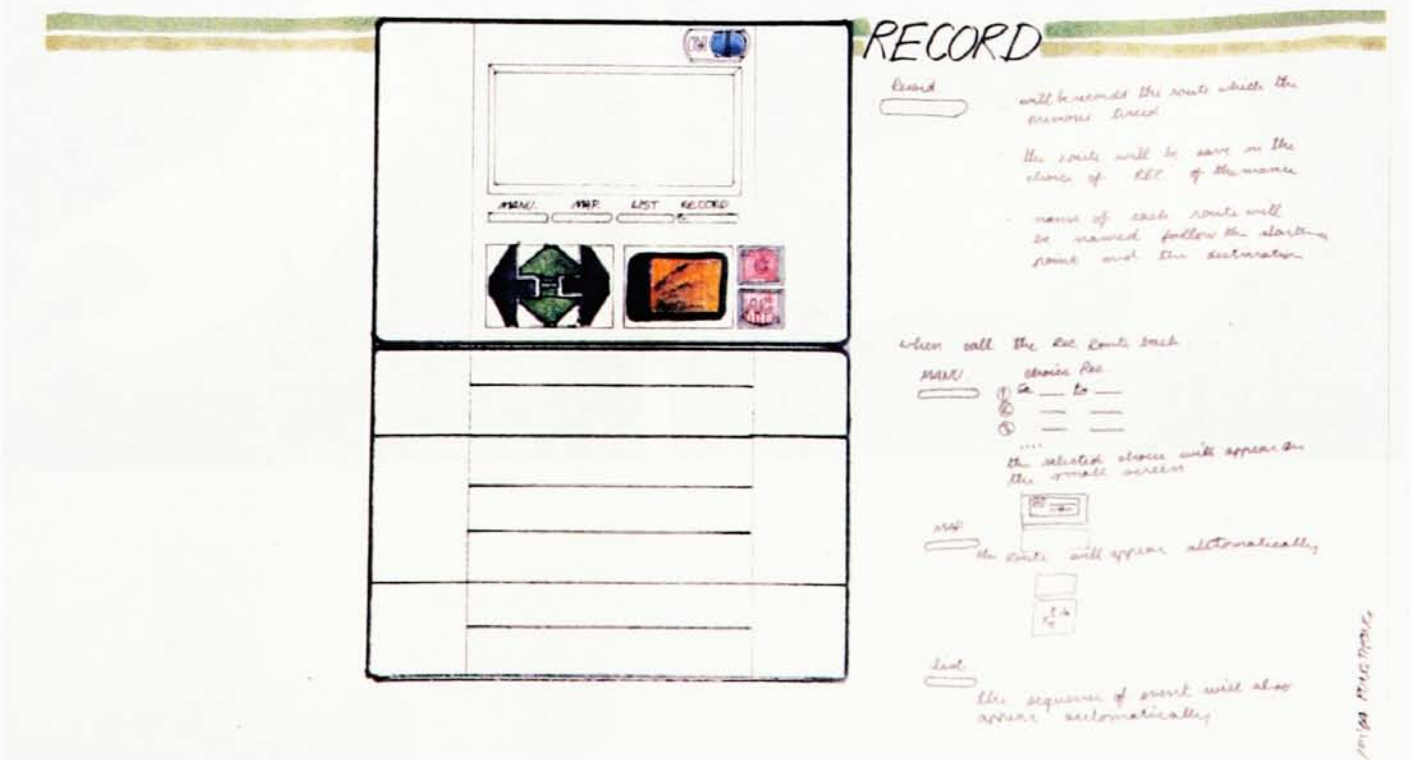




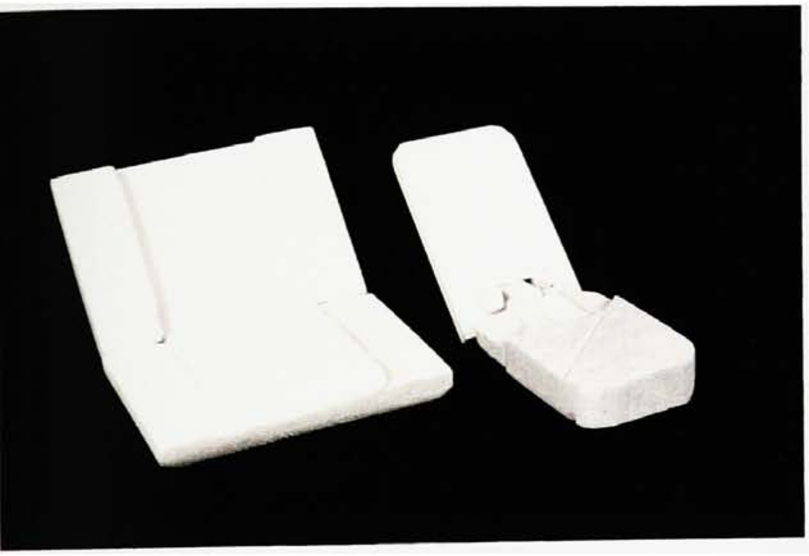
2) LIST Experiment how to display the direction in sequence by words.

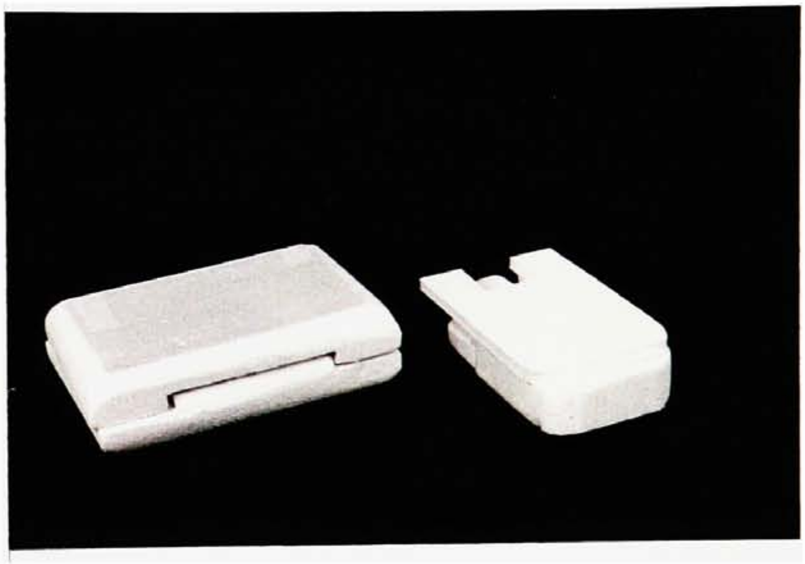
3) MAP Experiment how to display the direction in sequence by graphic map.

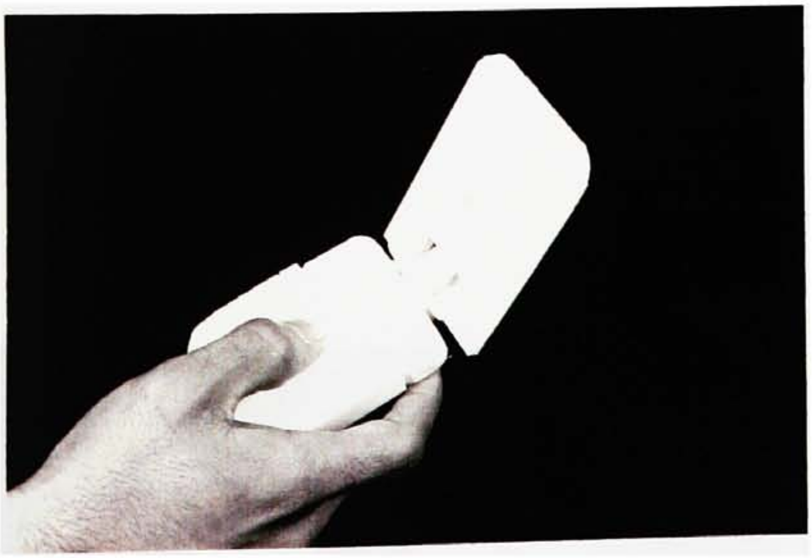
4) RECORD Record the prepared route.

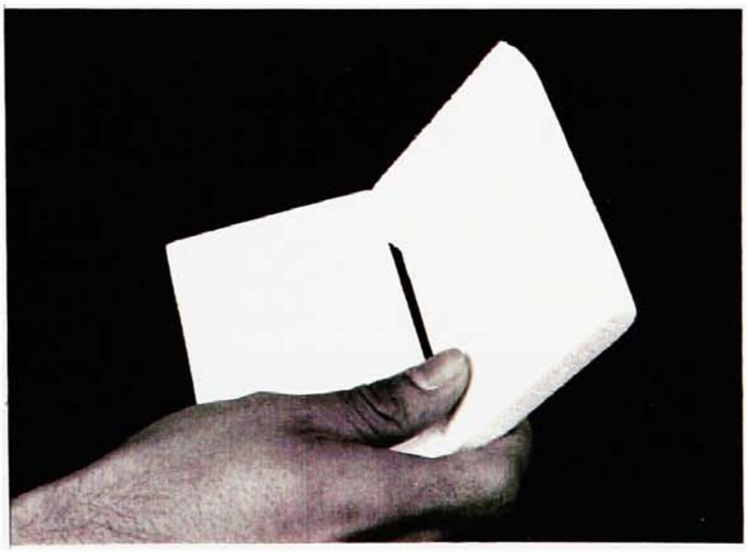


COMBINATION 1 : MOCK - UP MODELS
Experiment with models that are all different
in shape & size.

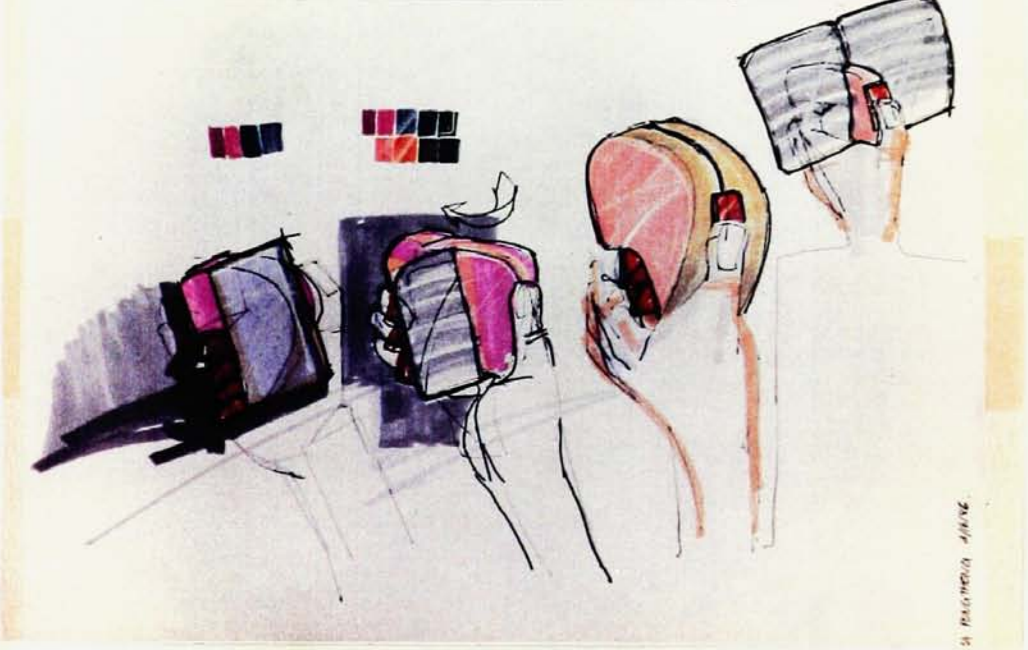


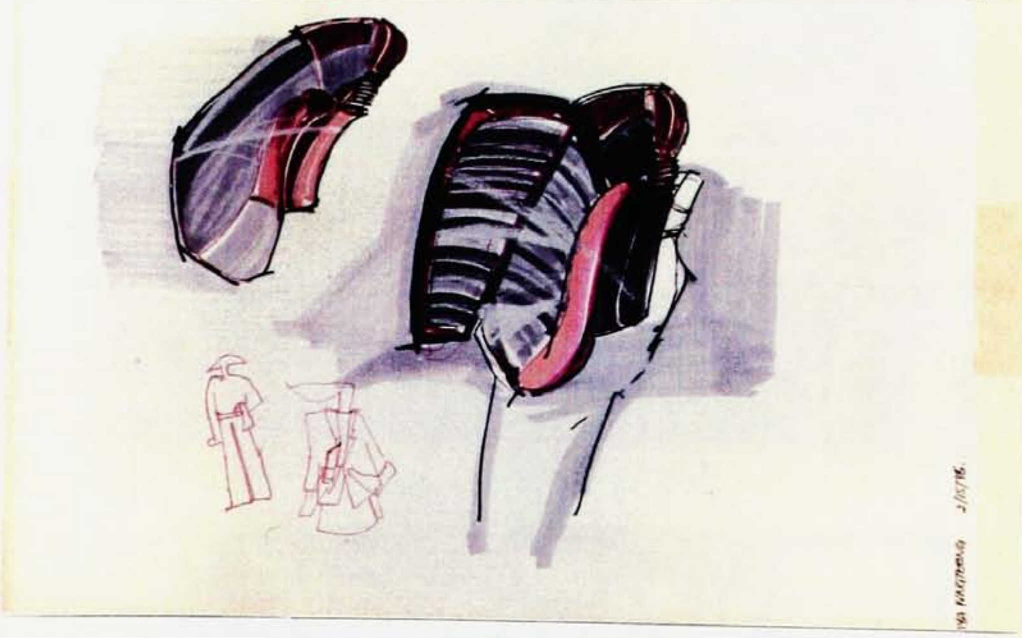


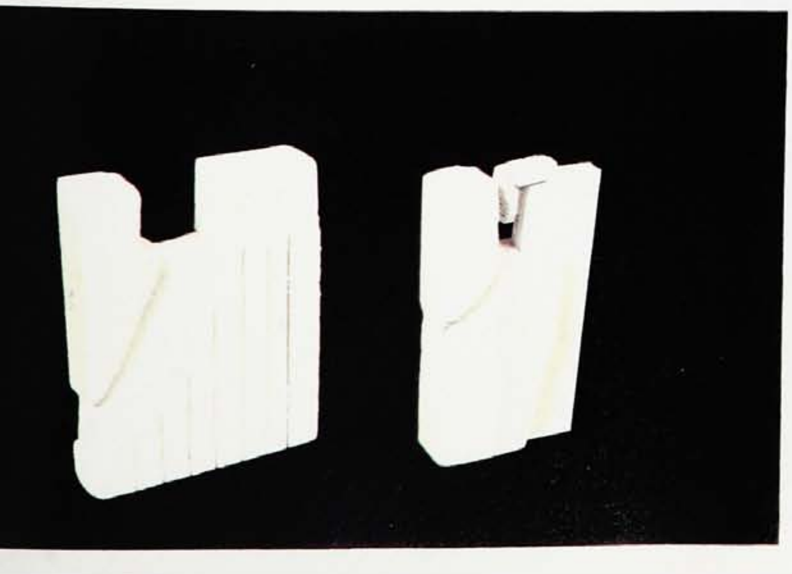


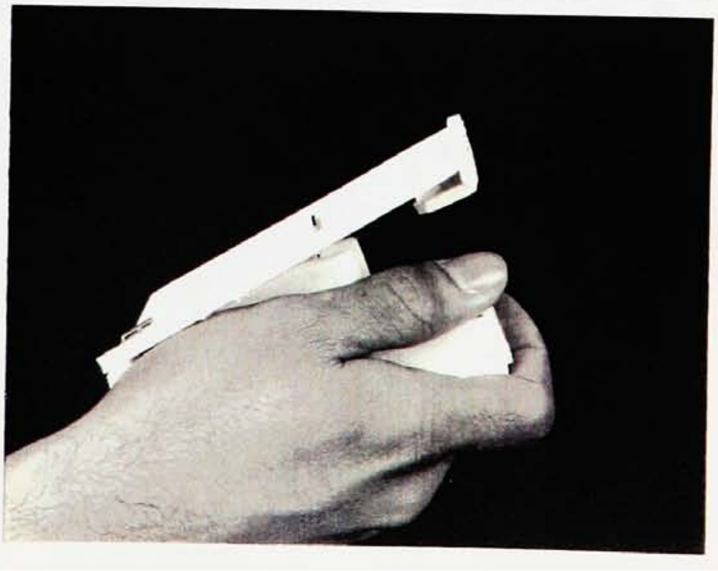


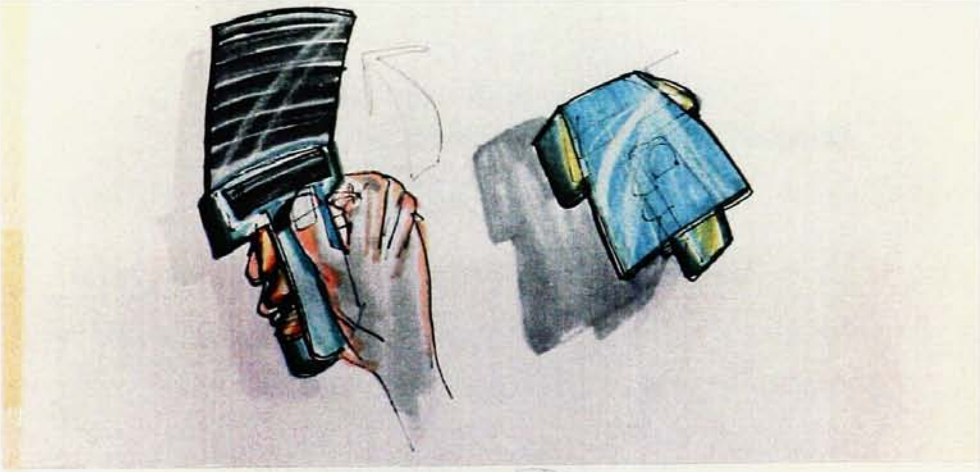
COMBINATION 1 : SKETCH & MOCK - UP MODEL
Experiment on " open - up " screen
in order to find the model that allows one hand
- to open up the lid
- to work with switch control while holding the tool

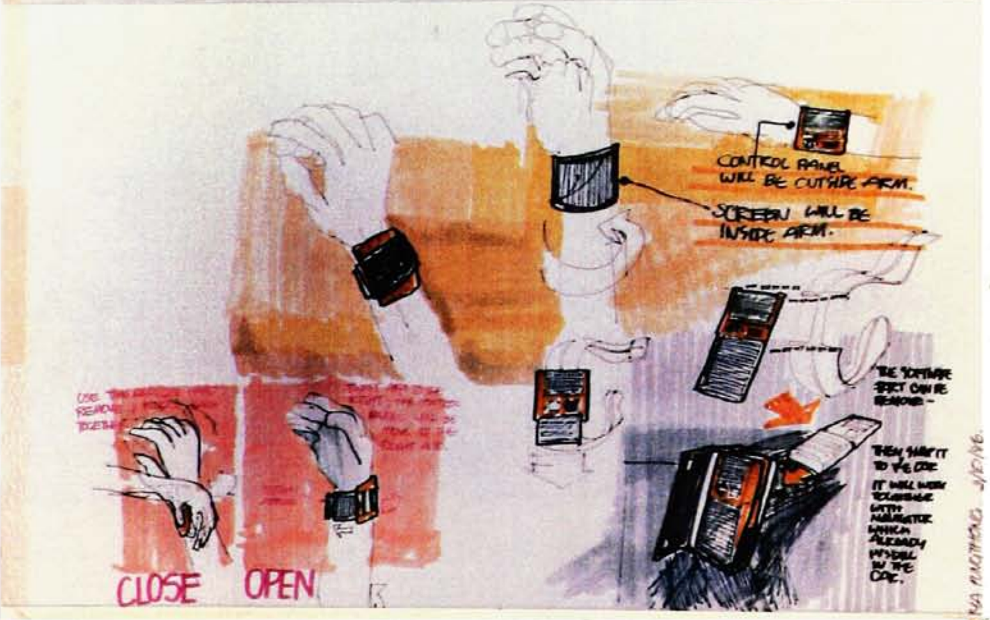


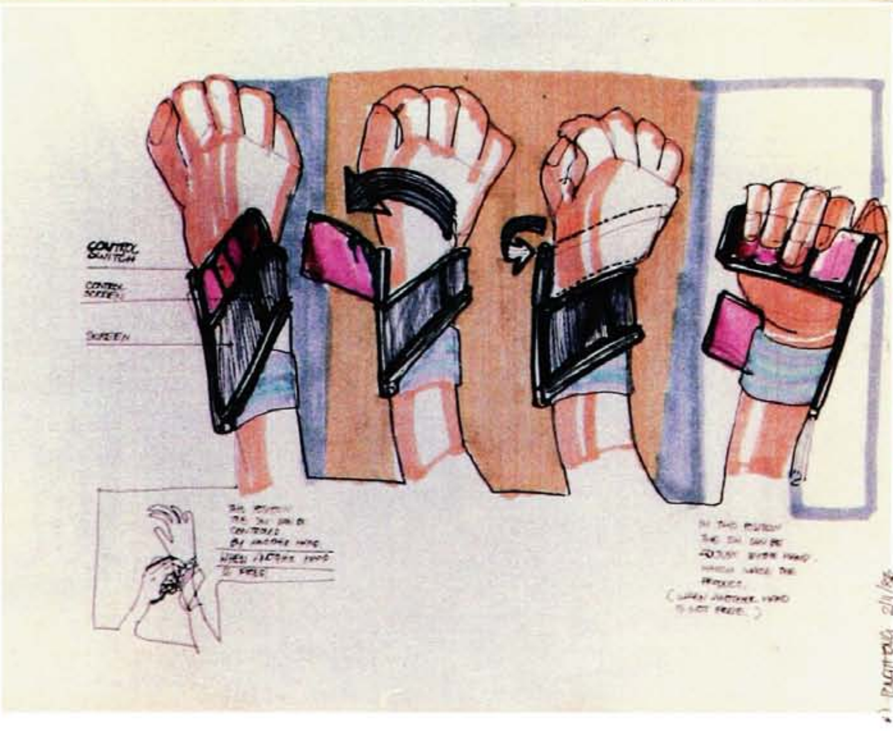






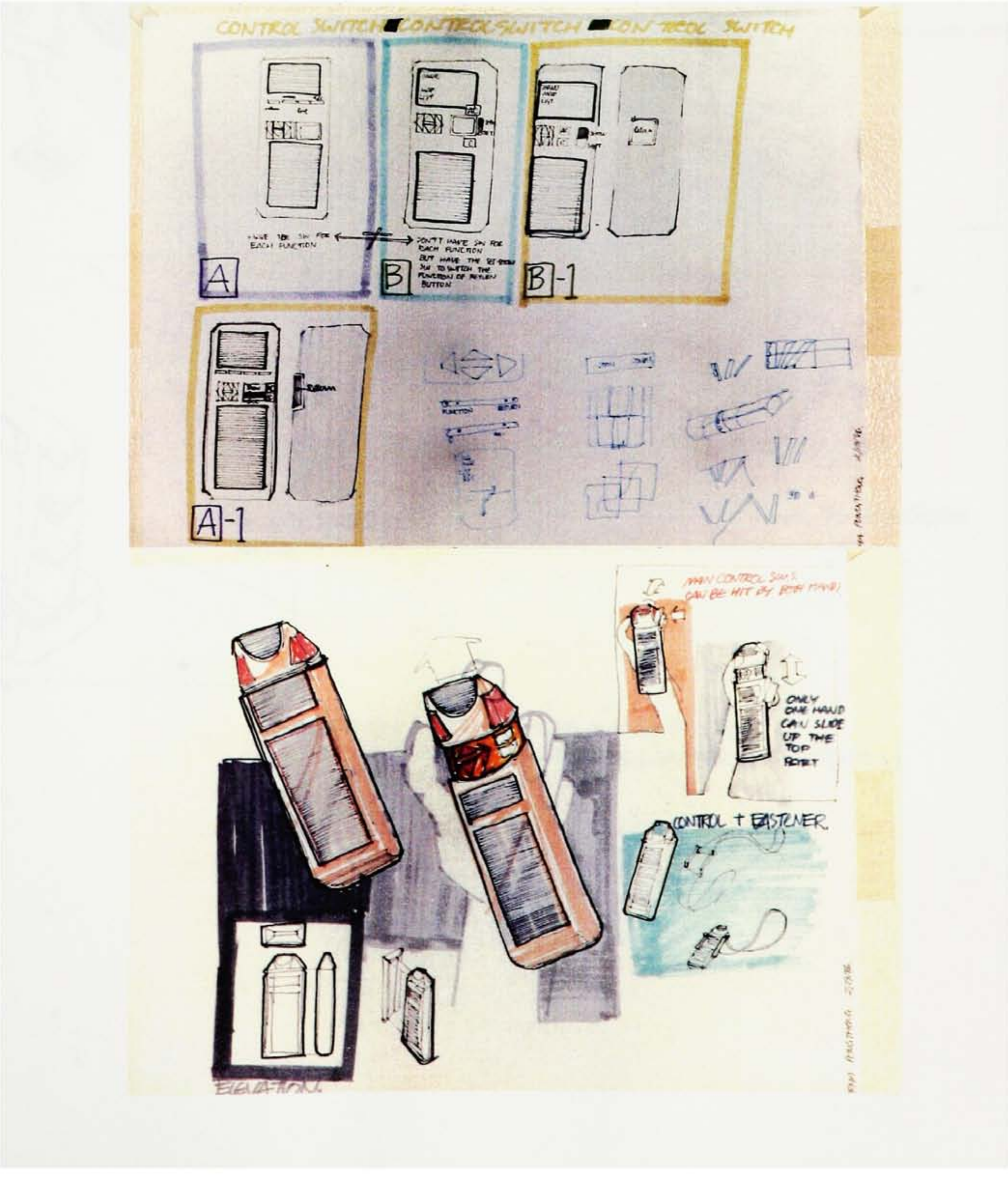


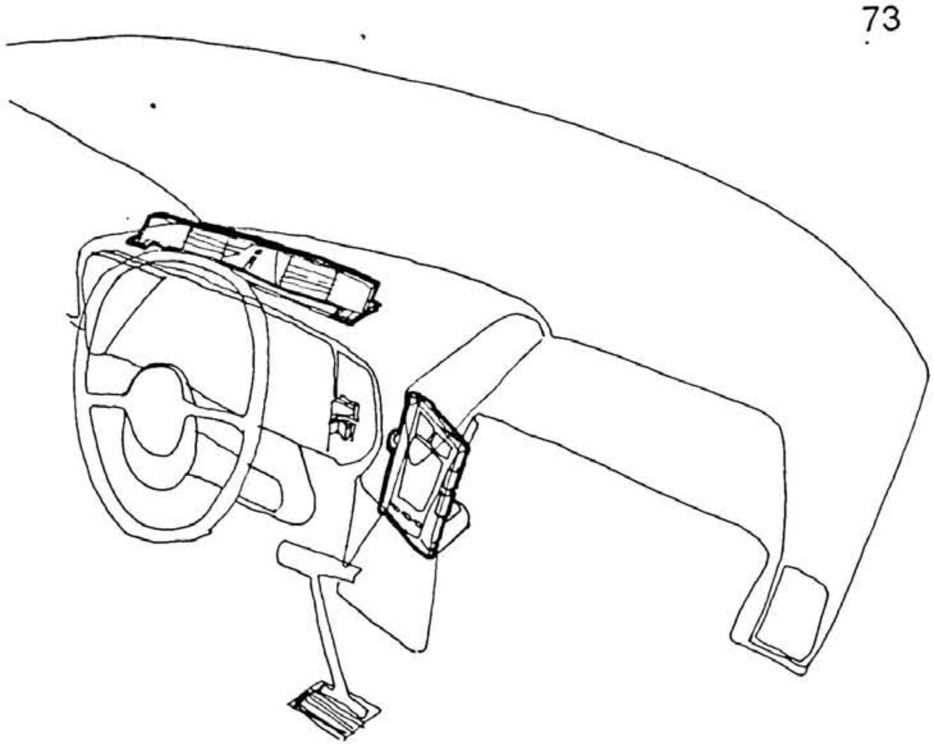

CONTROL PANEL
WILL BE OUTSIDE ARM.
SCREEN WILL BE
INSIDE ARM.
CLOSE
OPEN

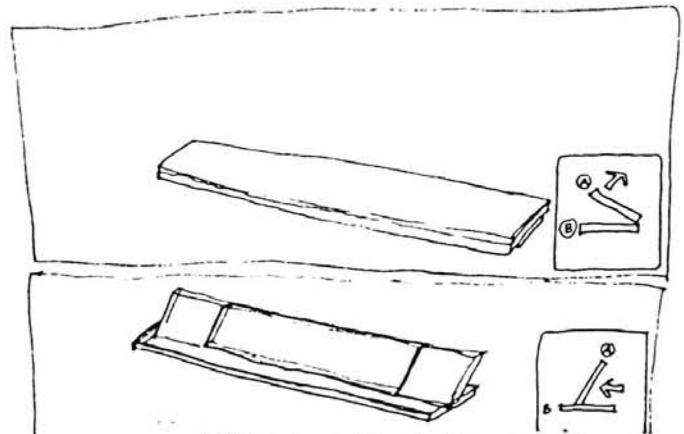

SCREEN

COMBINATION 2

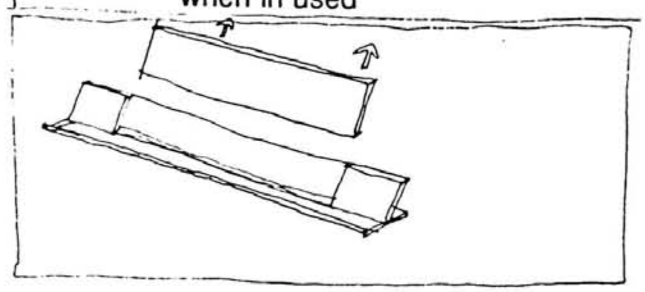
- One Piece Hand Tool
- No lid cover screen and function switches
(The single piece tool is the ideal for convenience.)

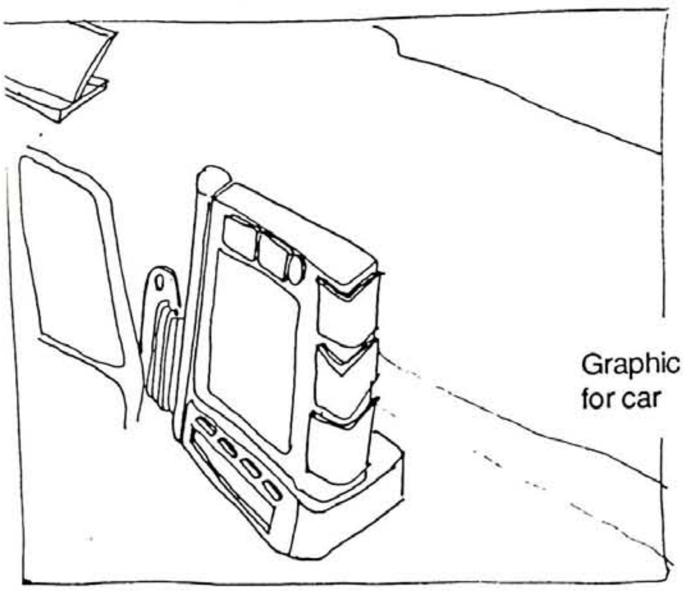




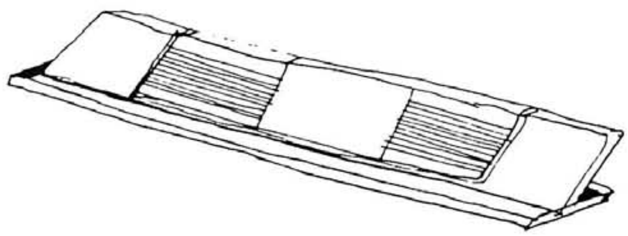


Flipped up Route Turning Signal
when in used





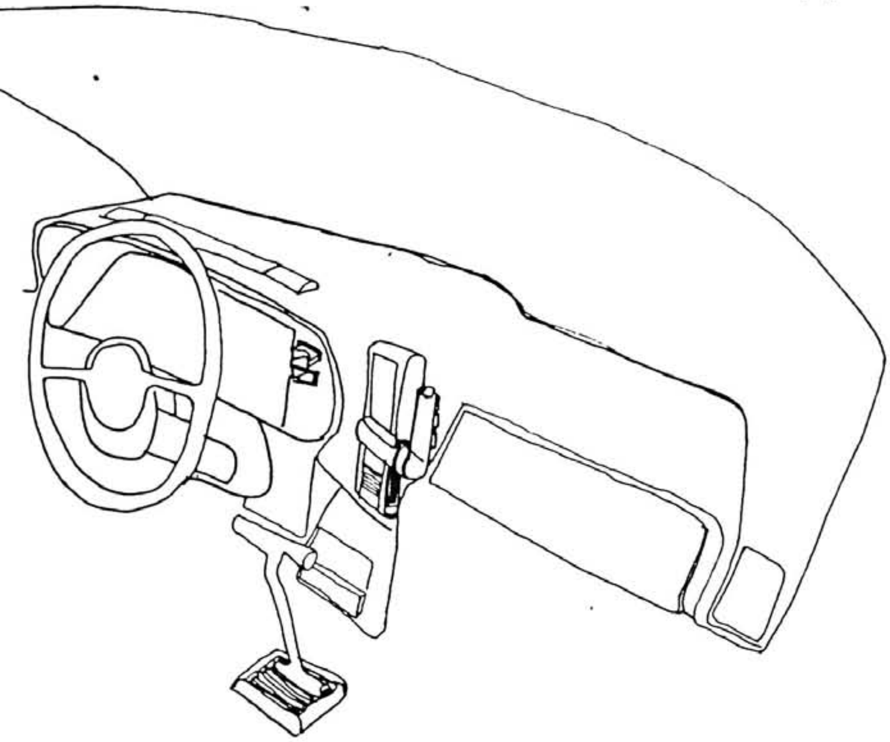
Graphic Map Display
for car

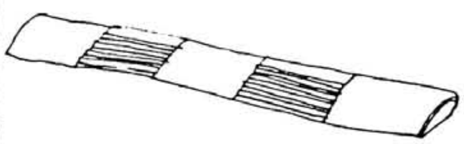


Route Turning Signal

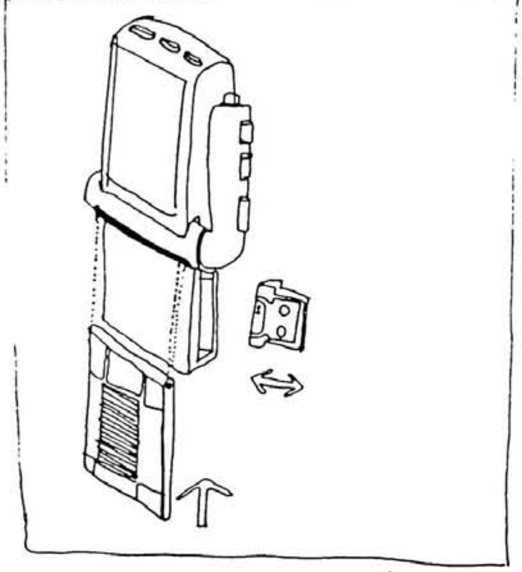
URIYA PUNGTHONG 1/29/86

COMBINATION 2 : BRING PORT-A-MAP TO CAR
Bring portable map used with car (design # 1)

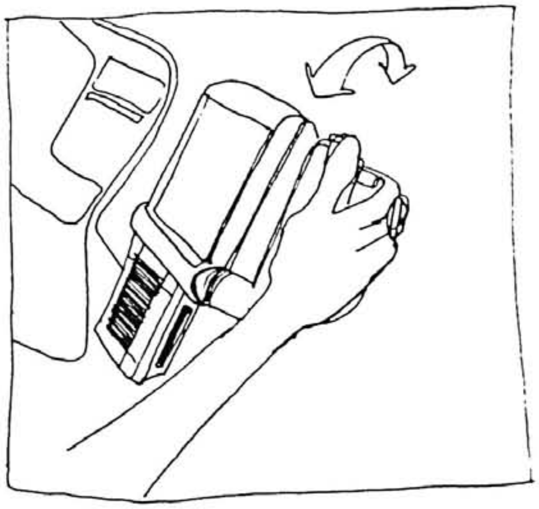


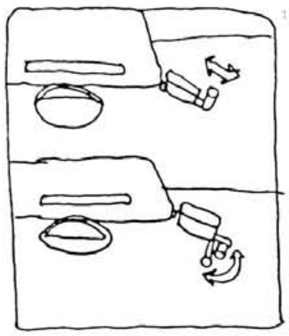


Route Turning Signal



Input Port-A-Map and a software cassette



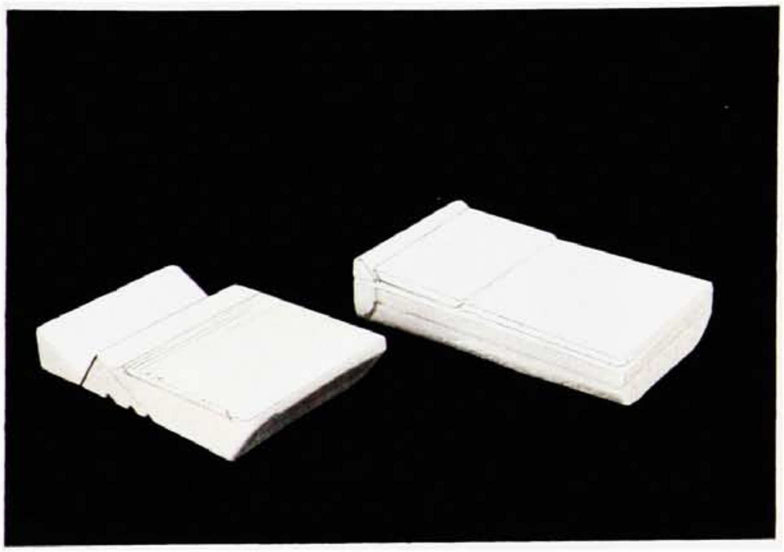


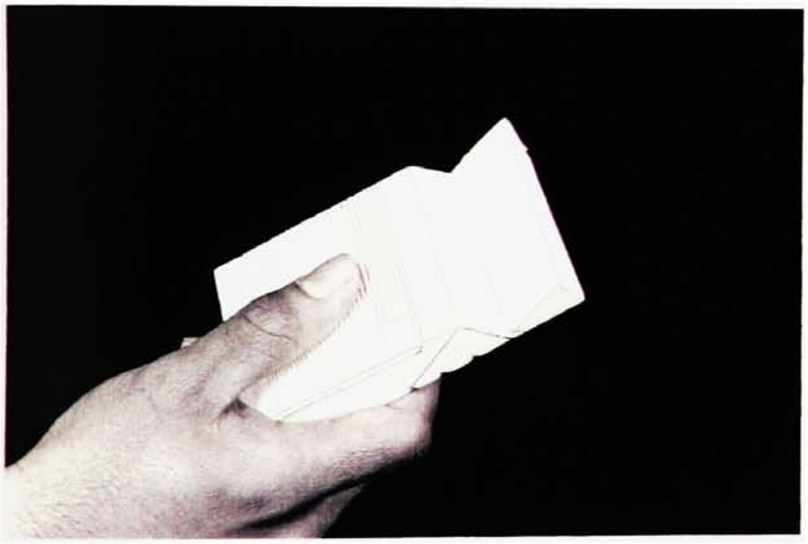
Graphic Map Display
for car with adjustable socket

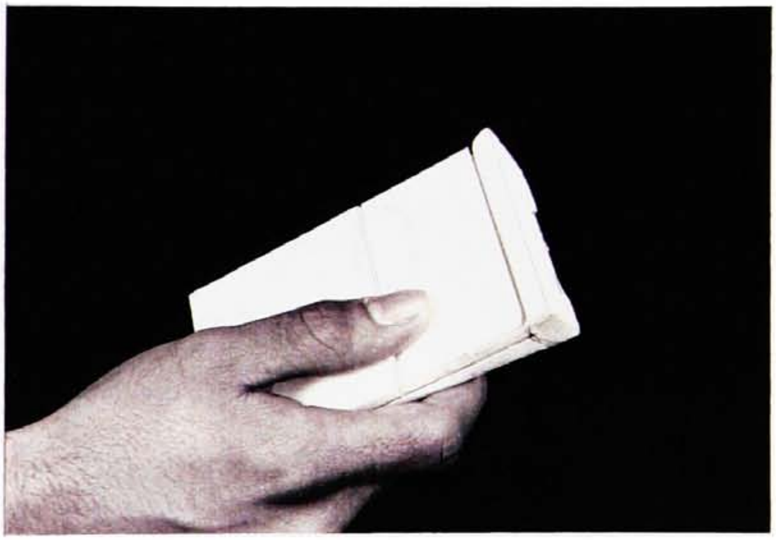
COMBINATION 2 : BRING PORT-A-MAP TO CAR
Bring portable map used with car (design # 2)

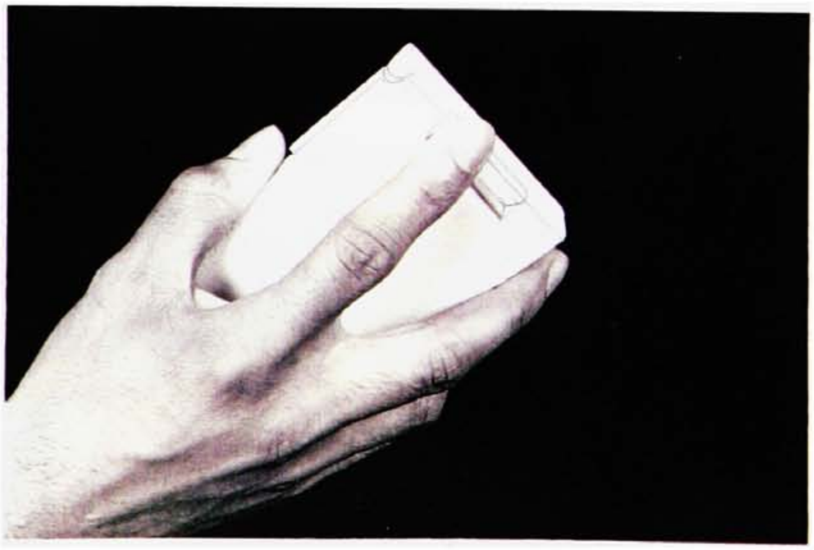
COMBINATION 2 : MOCK - UP MODELS

Experiment on hand 's position when holding the device and controlling switches designed on the back of the screen.



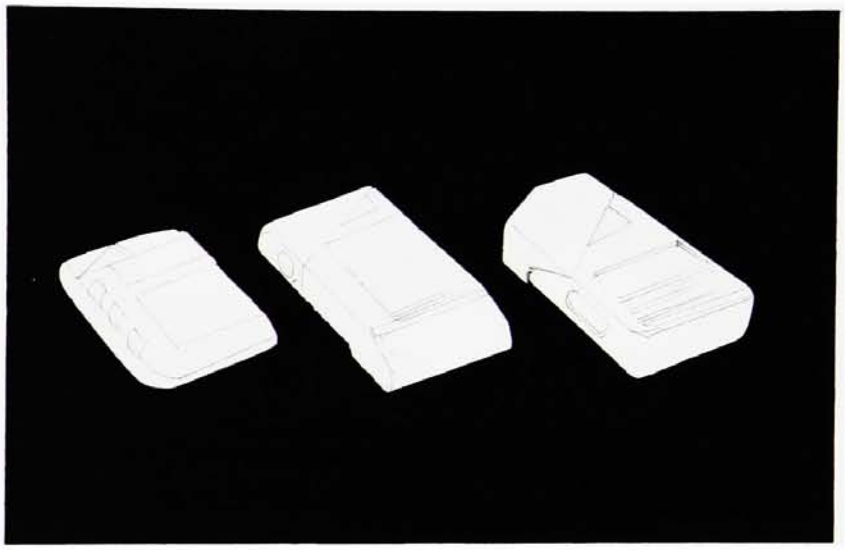






Large size model offers a big screen but its width cause problem for small hand to move finger on switches while holding the tool.

COMBINATION 2 : MOCK - UP MODELS
Experiment on hand 's position when holding the device and controling switches designed along the edge of the screen.



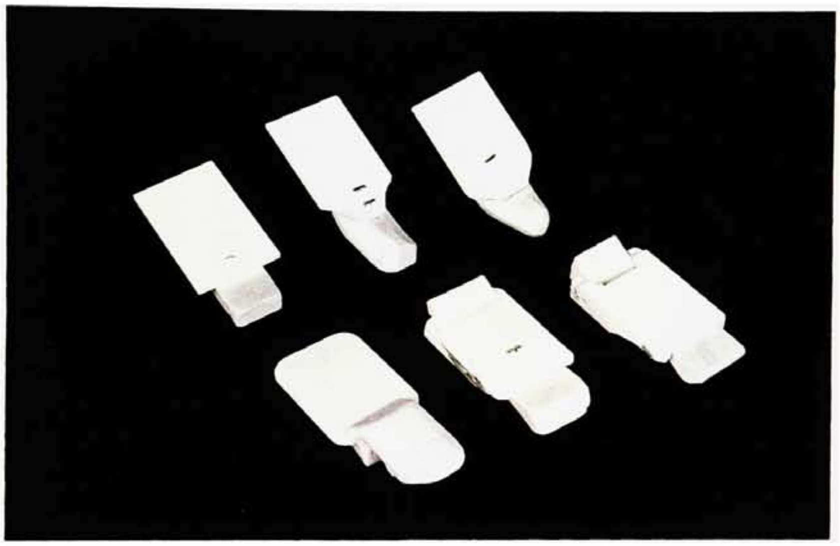
Small size tool with control switches on the edge of screen

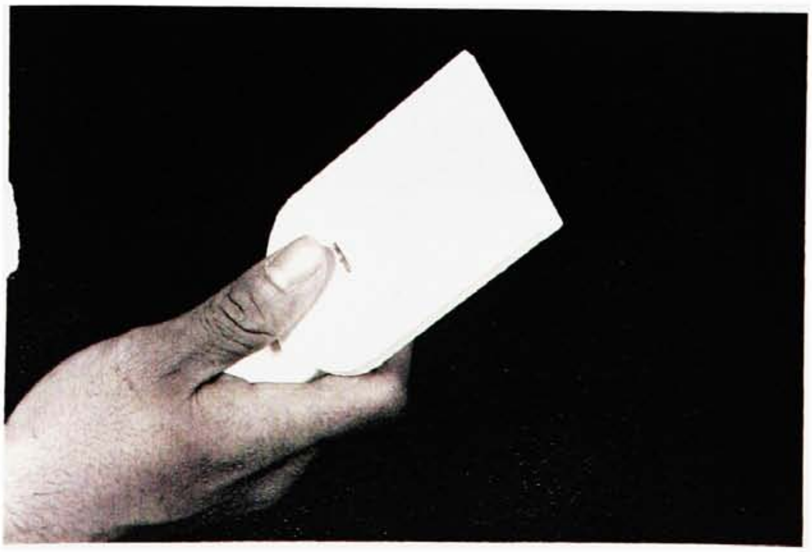
Small size tool fits into every palm size but its screen is too small.

COMBINATION 3

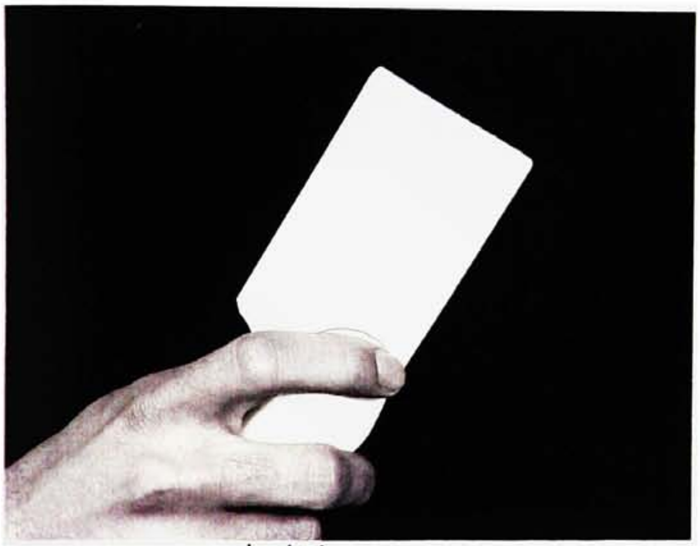
- The single piece hand tool
- with the " slide - in " handle

(The idea is to combine the big screen with the slim handle.)





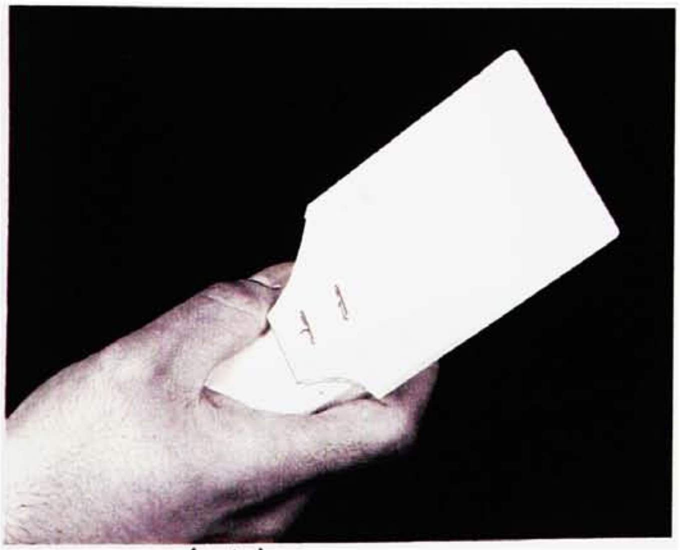
COMBINATION 3 : MOCK - UP MODELS
Experiment with the position to hold device by handle while the thumb is allowed to move freely on front handle.

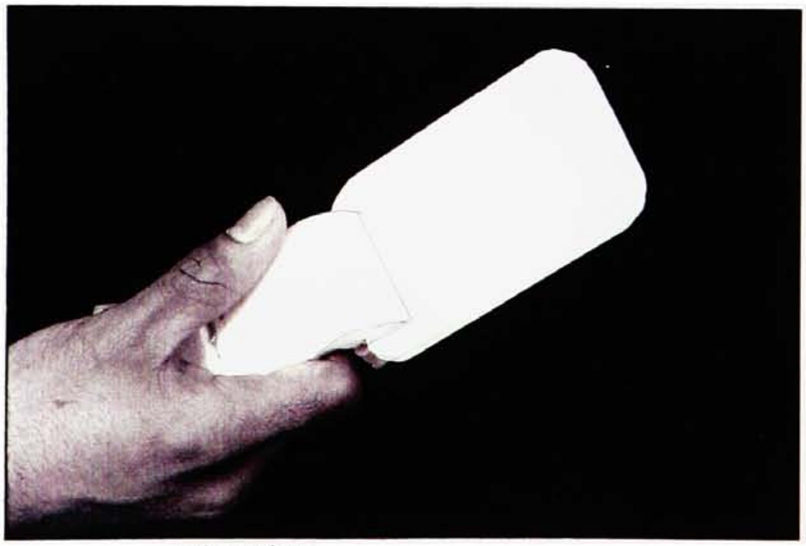

a.back view


b.back view

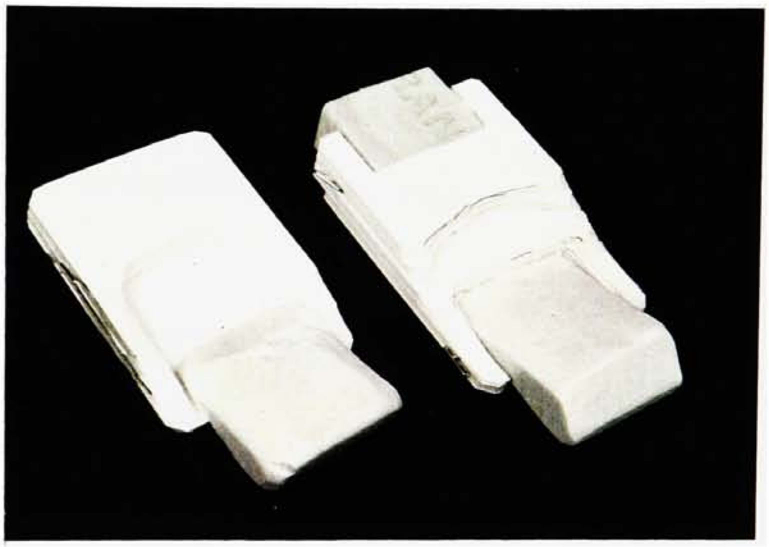
a. When the device has no design to help fit fingers into the back handle, the thumb has to help fingers hold the handle.

b.This model, the back handle is designed to increase firmness of grip without thumb.

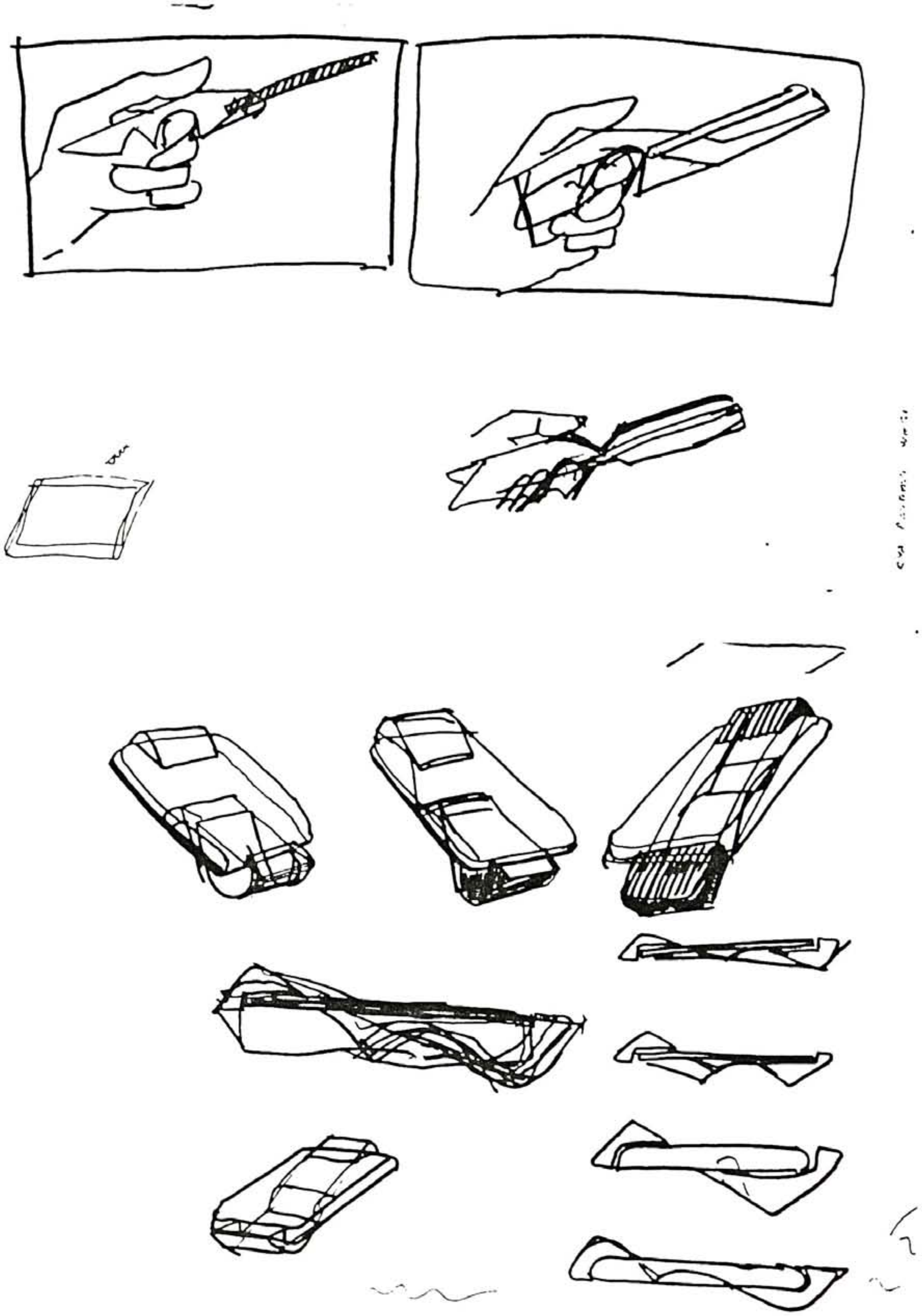

a.front view


b.front view

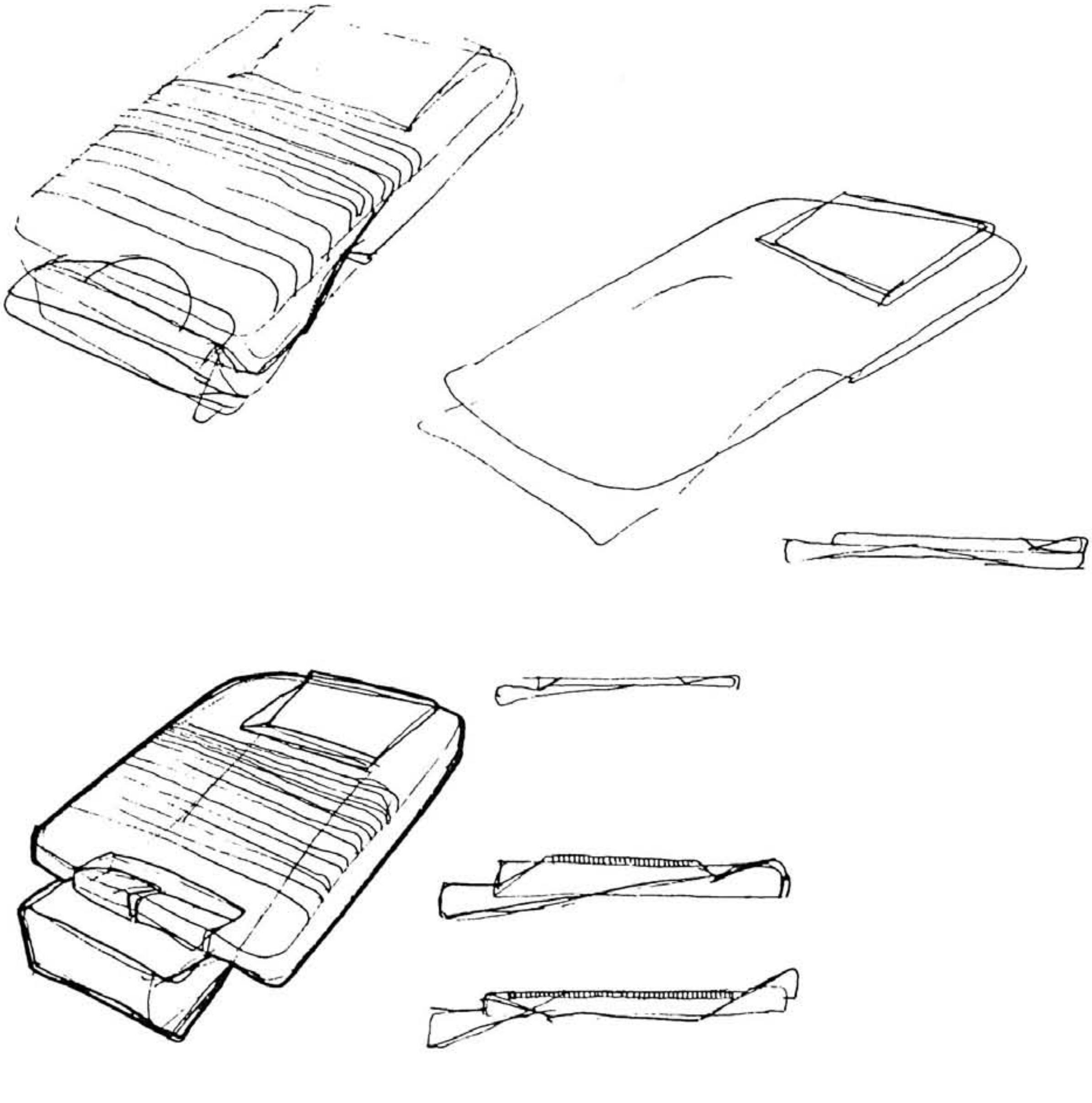
The other designs that help fit fingers into the back handle in order to increase firmly hand grip



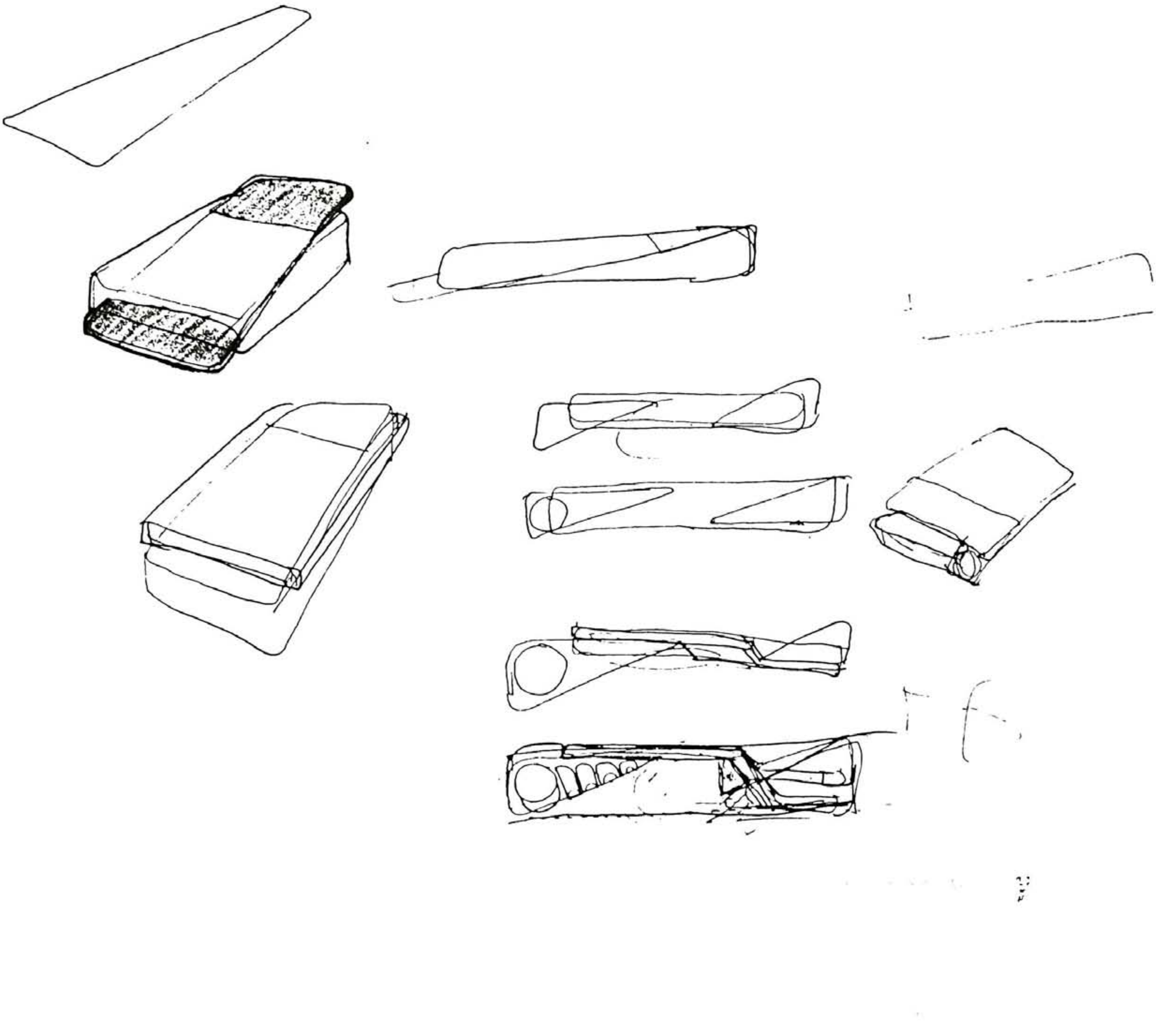
Sketch-design to develop
foam core mock-ups

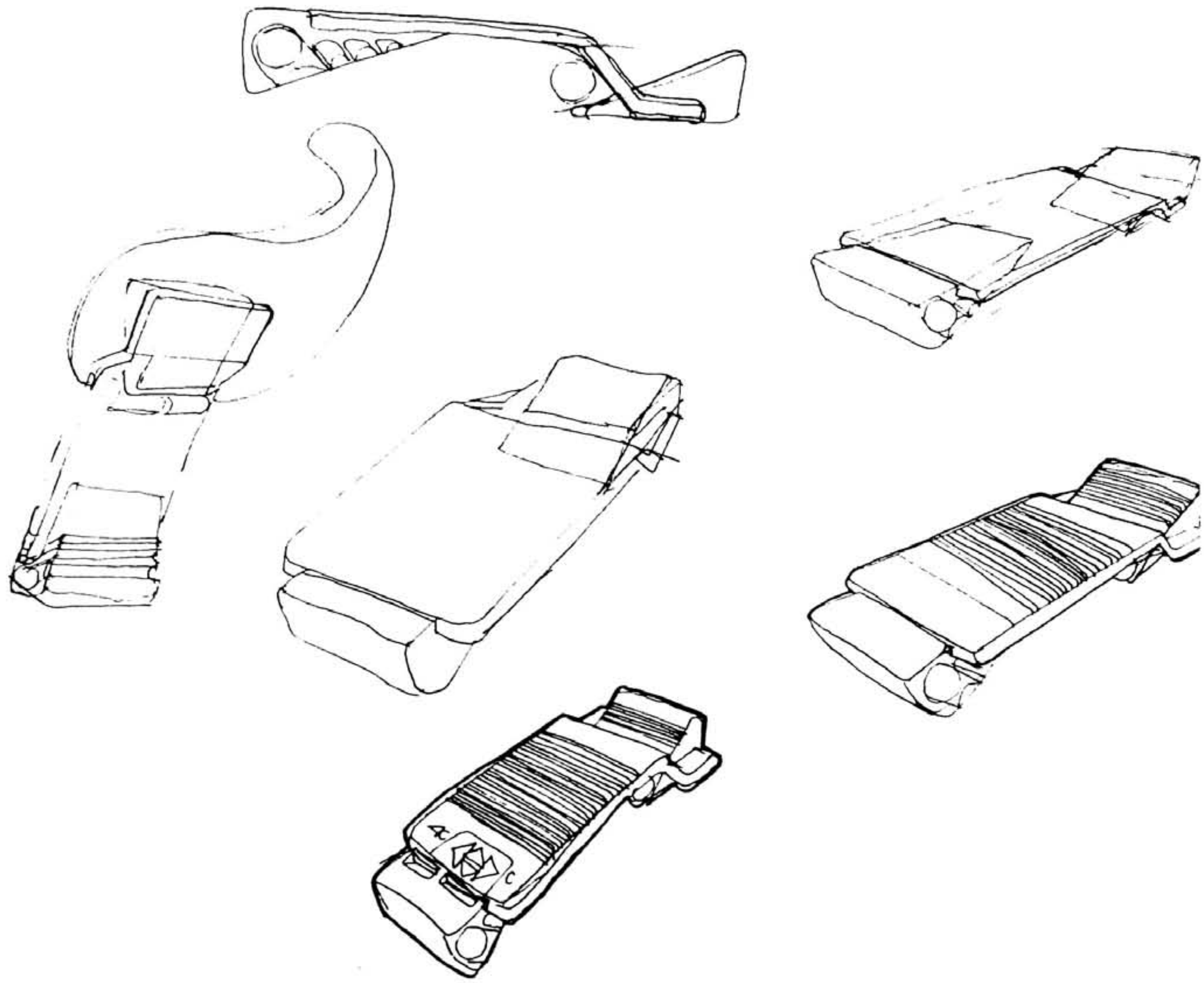


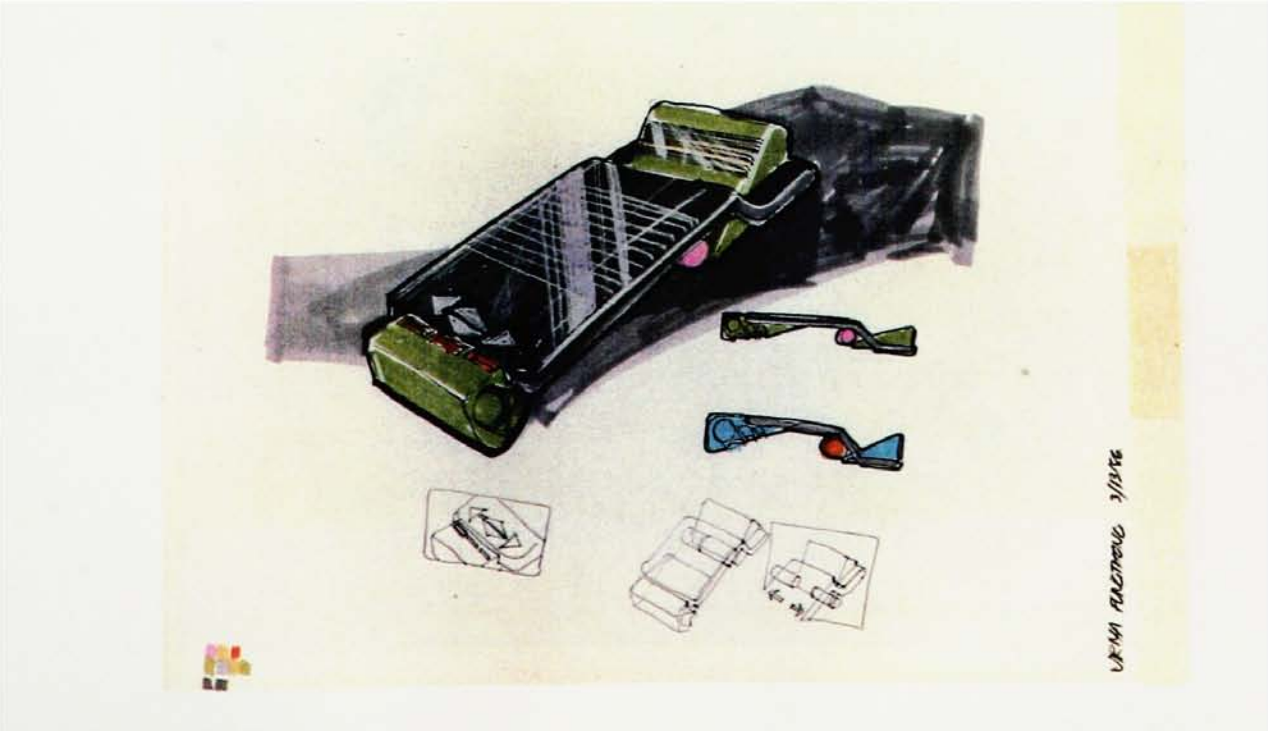
Sketch-design of the final model no. 1



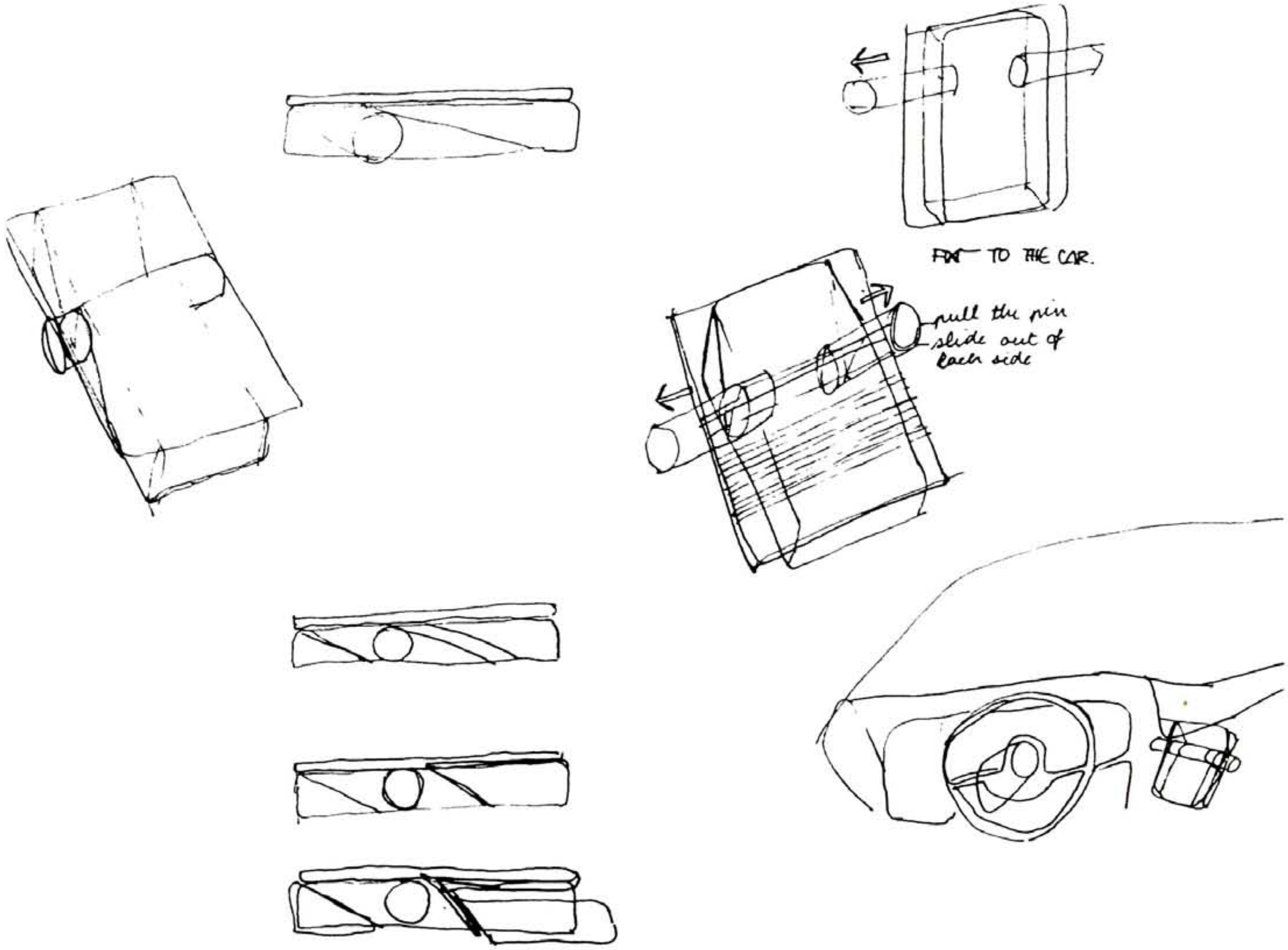
Sketch-design of the final model no. 2

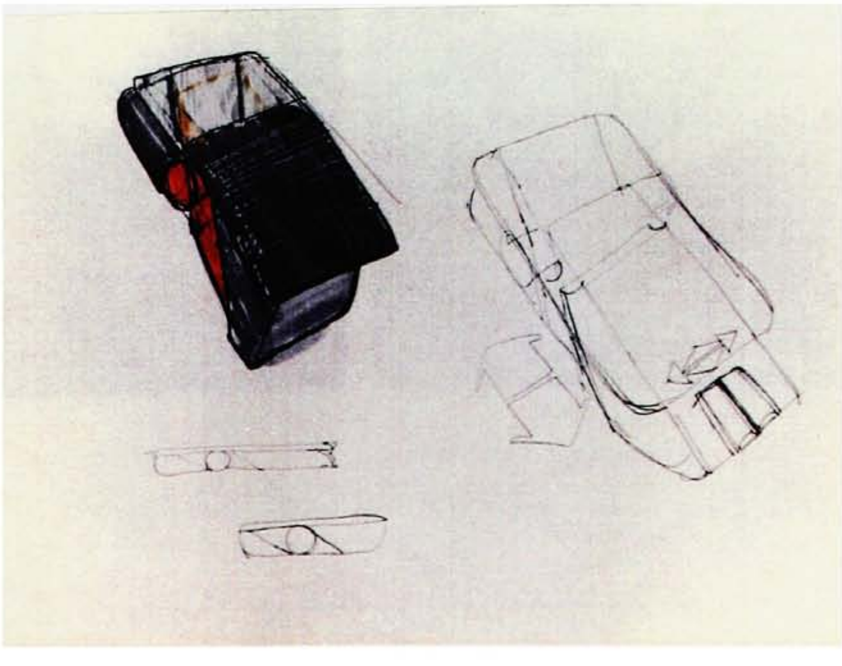




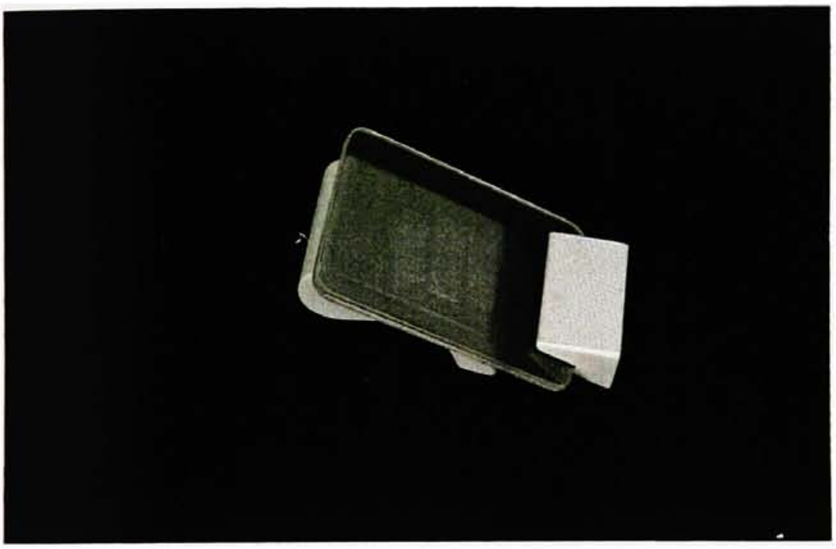


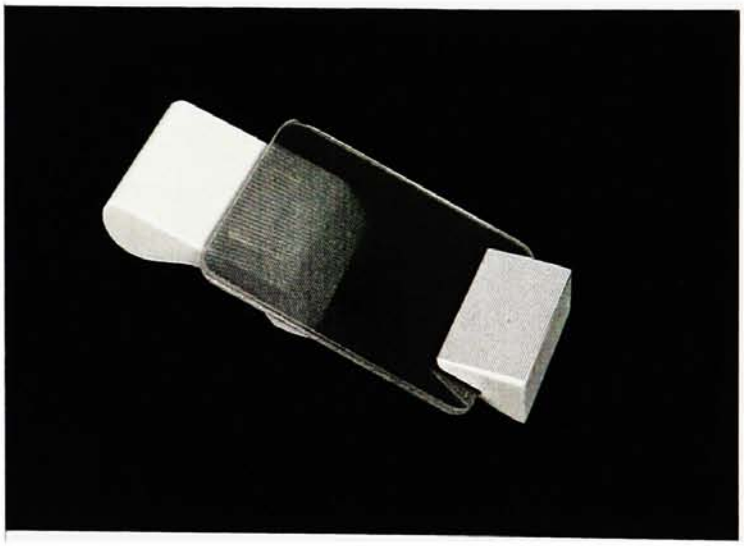
Sketch-design of the final model no. 3

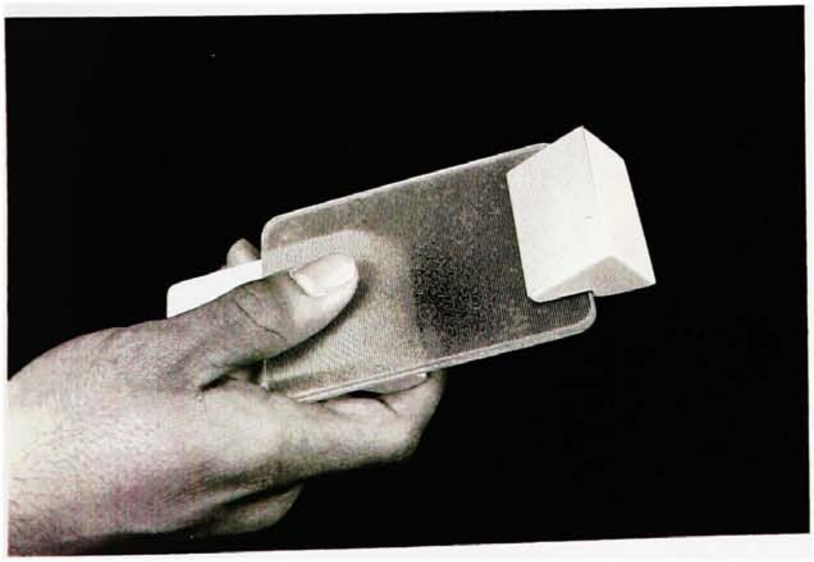


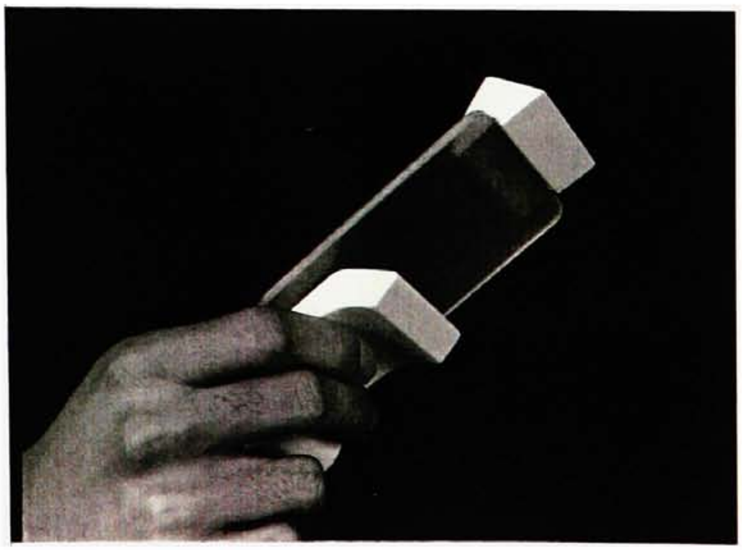


COMBINATION 3 : MOCK - UP MODELS: THE FINAL MODEL #1
To compare the three final sketches in
three dimensional design.

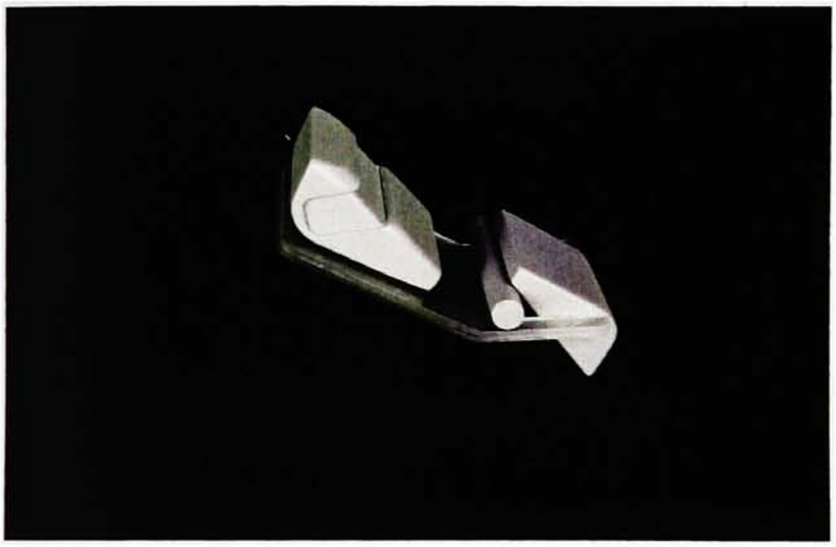


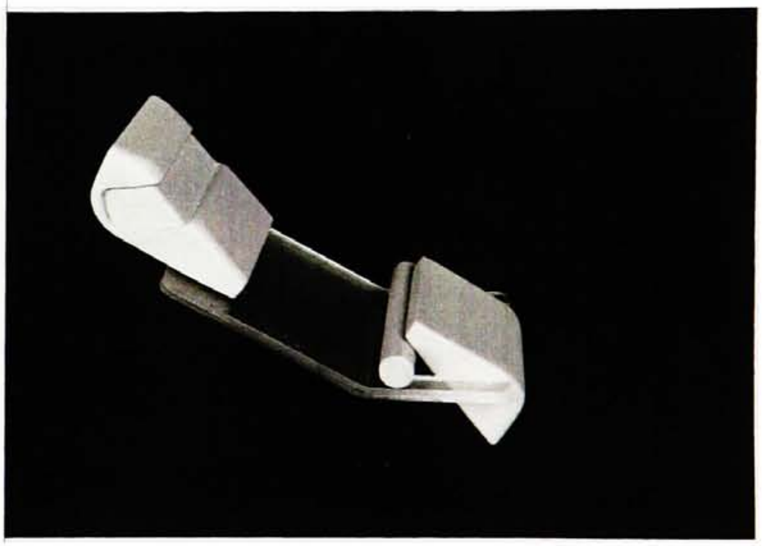


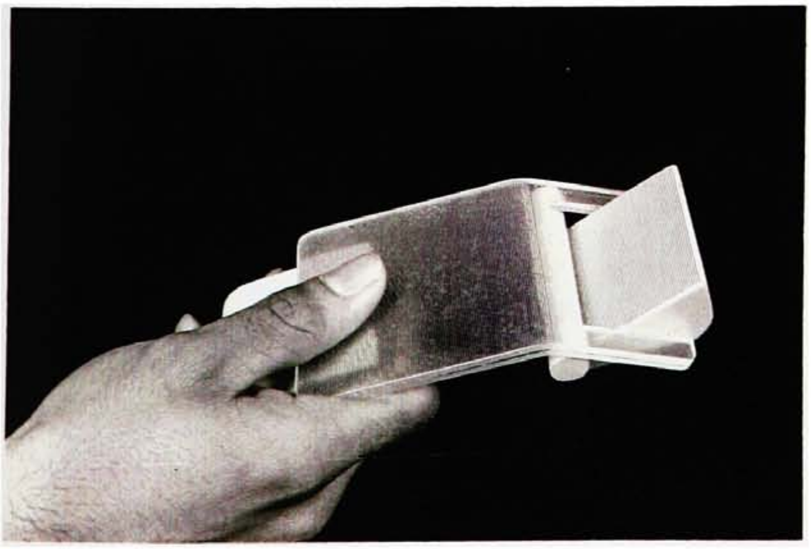




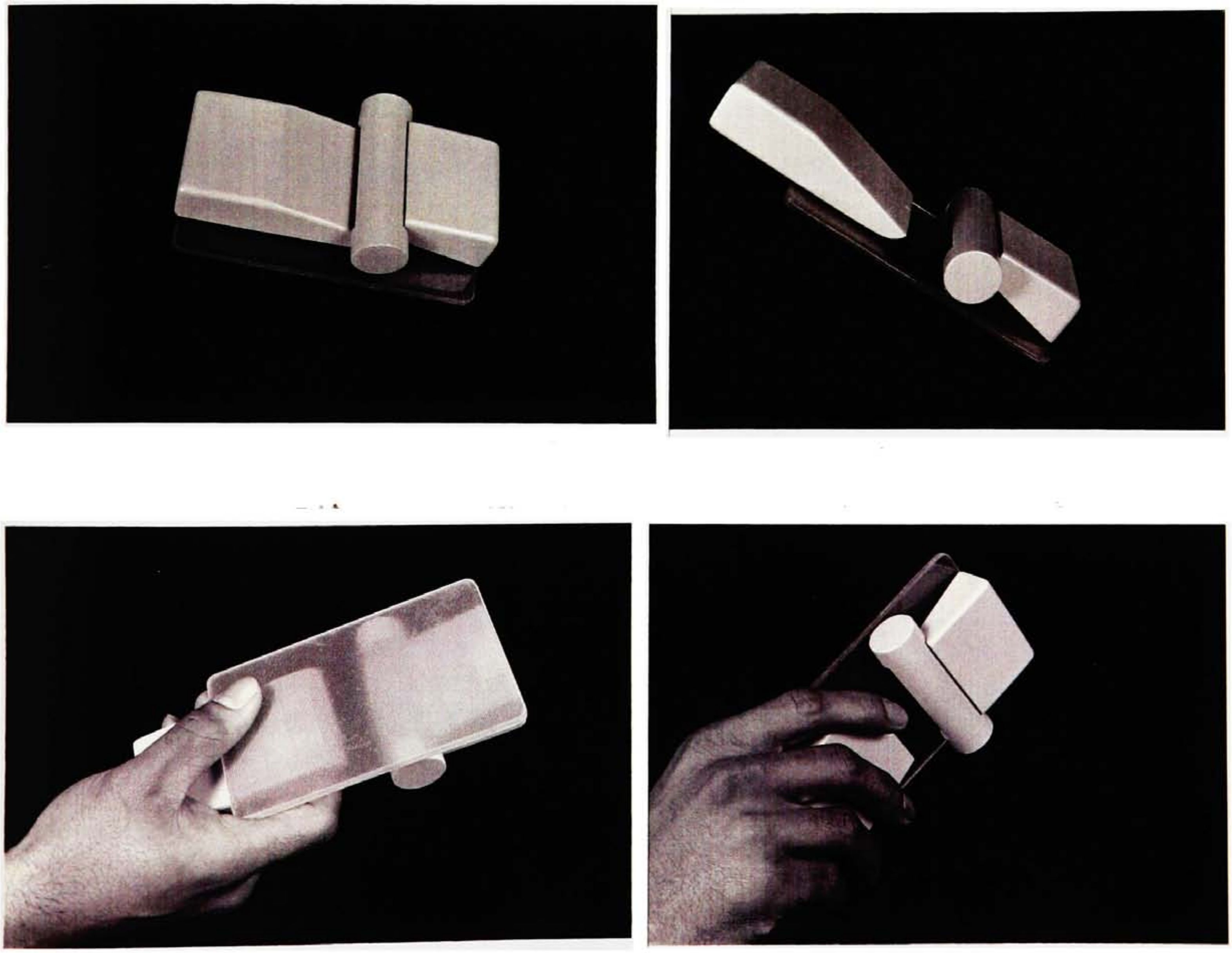
COMBINATION 3 : MOCK - UP MODELS: THE FINAL MODEL #2



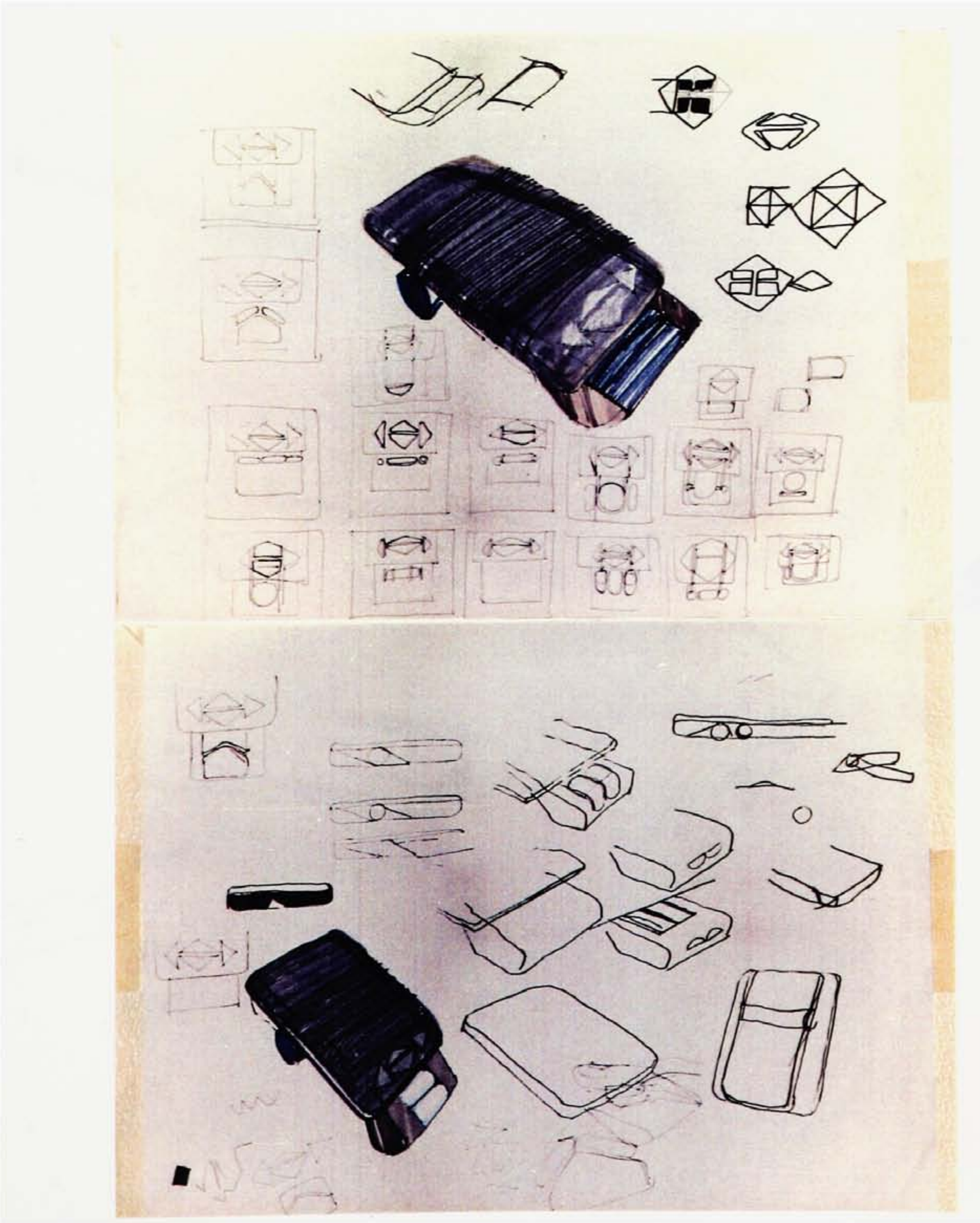




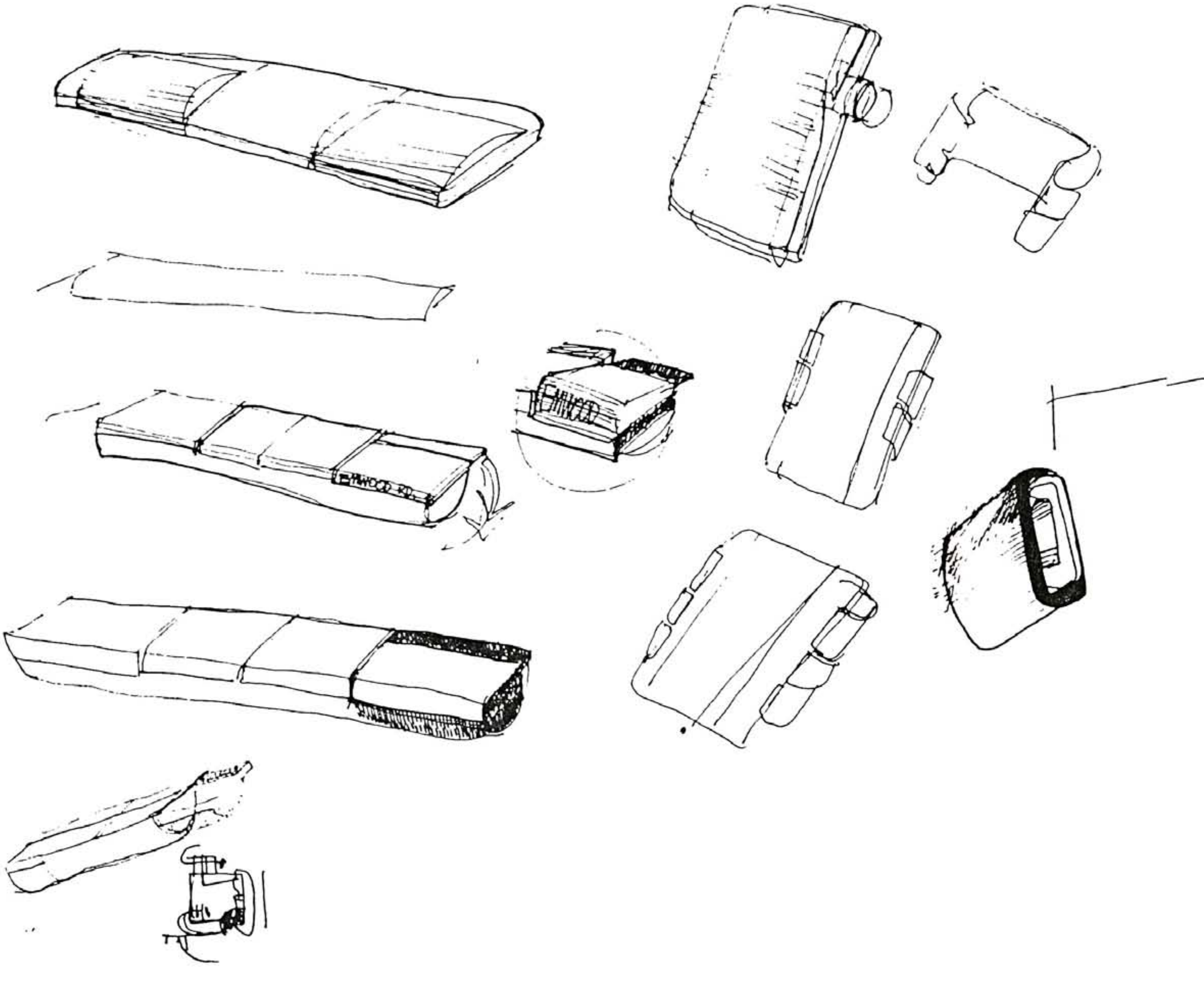
COMBINATION 3 : MOCK - UP MODELS: THE FINAL MODEL #3



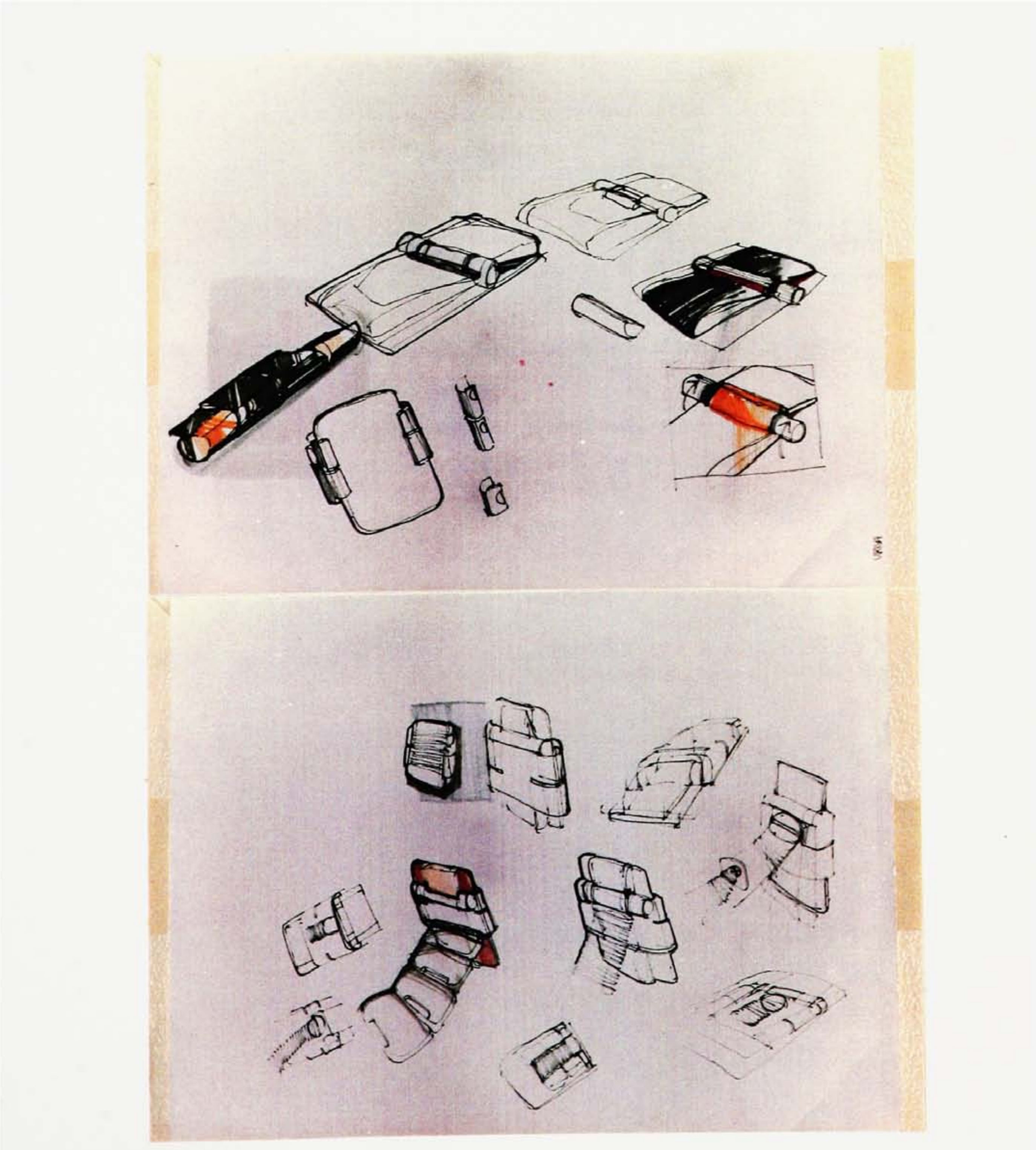
COMBINATION 3 : DESIGN DEVELOPMENT OF THE FINAL MODEL #3
Designing control switches on portable tool



COMBINATION 3 : DESIGN DEVELOPMENT OF THE FINAL MODEL #3
Designing Route Turning Signal & switch socket
for car use



COMBINATION 3 : DESIGN DEVELOPMENT OF THE FINAL MODEL #3
Developing the design of Route Turning Signal
& switch socket



CHAPTER IX

FINAL DESIGN

The final design of the Intelligent Mapping is composed of two main features :

1. The Port - A - Map : for portable use.
2. The Car Map : Port - A - Map also available for car use

Details of both features are demonstrated on these following pages :

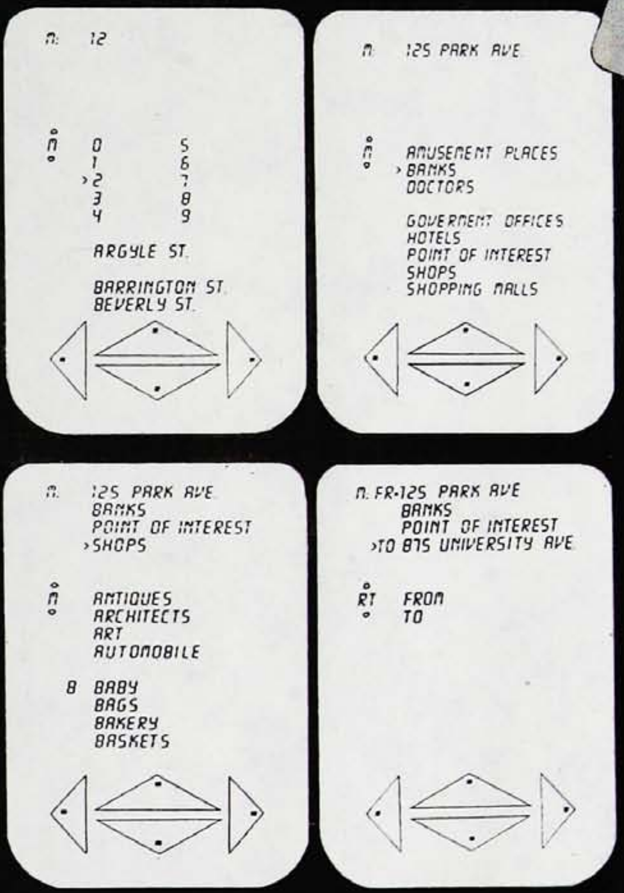
PORT-A-MAP

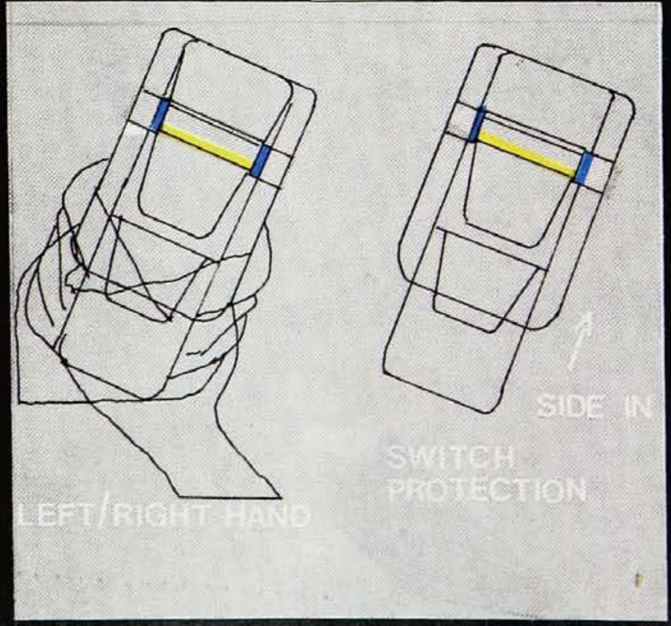
Port - A - Map is designed to accompany travelers as a tourist guide to give direction , trip information and descriptions of places. Map and text are made dynamic and interactive to the environment in a handy package.

Activating the navigation switch displays the map so that the top corresponds to the user's direction. A scroll and pick system offers a simple way to mark one 's position on the map or key in the characters on the text display. The user receives both text message and graphic information from the microprocessor and its database. Port-A-Map is able to provide the location on the map for a street address input ; it can find or plan a route, and it can describe a trip or place.

Port-A-Map obtains its data from a network station. This is accomplished by plugging it into a data vending machine located at a tourist site , hotel , information booth , etc., or it can be done at home.

PLANNING YOUR ROUTE





THE STRUCTURE ,FORM ,COLOR AND GRAPHIC OF THE DEVICE SUPPORTS ITS FUNCTION :

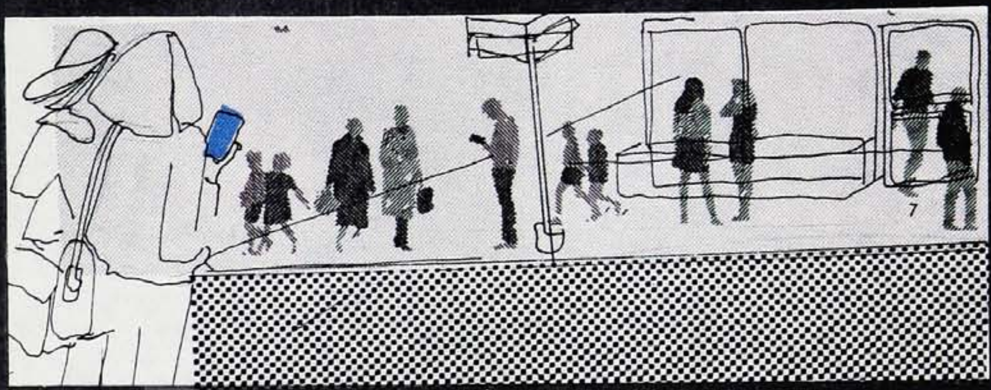
Port-A-Map 's form was derived from experimentation with a number of mock-ups. The form allows one - hand control. A large hand can hold the product from edge to edge of the display, while a small hand can fit the palm over the back of the case. Either way allows the thumb to move freely over the front buttons. Control buttons are located on both sides. The " input " and " change message " buttons are in the handle where they will be protected when the handle slides back. The " display on / off " and " magnify " buttons are on the back.

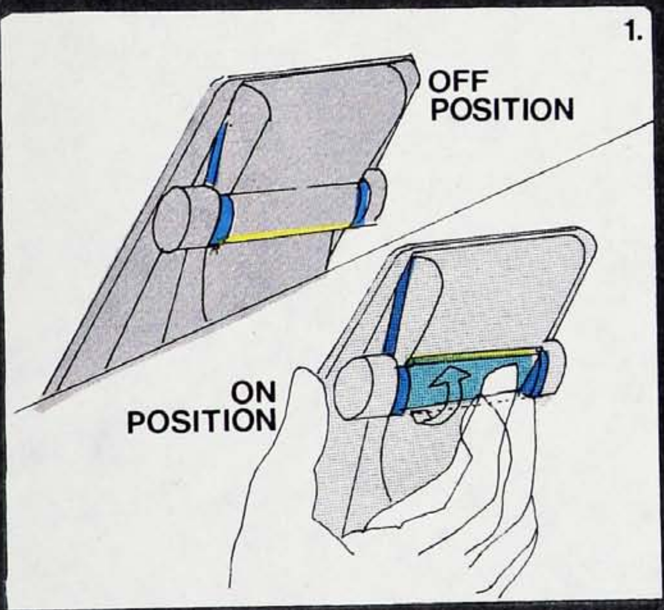
Port-A-Map 's color is light warm gray to convey the light weight of the product. The buttons are blue , turquoise and yellow to harmonize and yet be easily distinguishable.

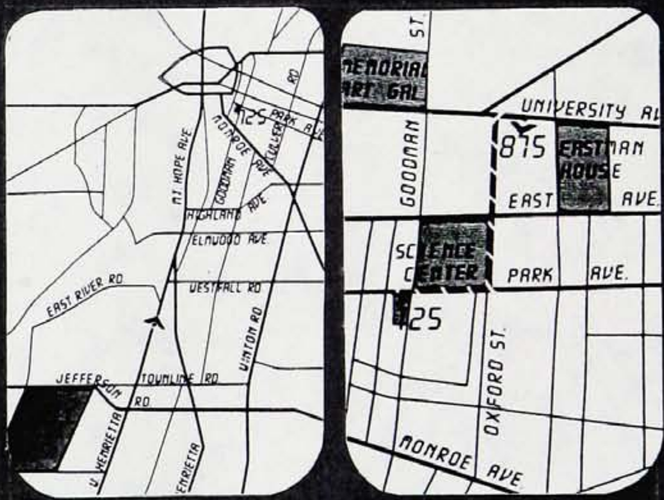
MATERIALS AND MANUFACTURING PROCESSES :

Port-A-Map 's case is injection molded of a high - impact thermoplastic. The display is protected by a transparent polycarbonate lens with non - glare treatment. All buttons have an elastomer coating.

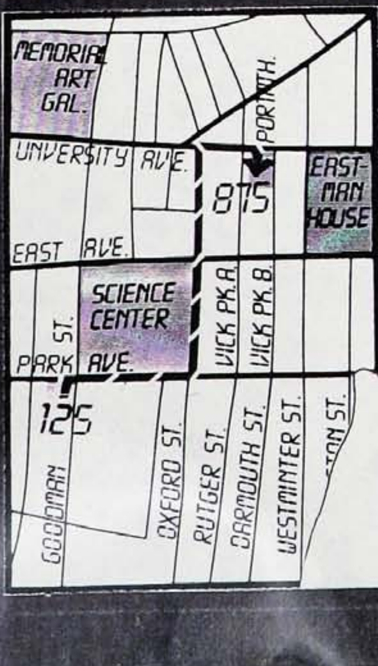
AREA MAP

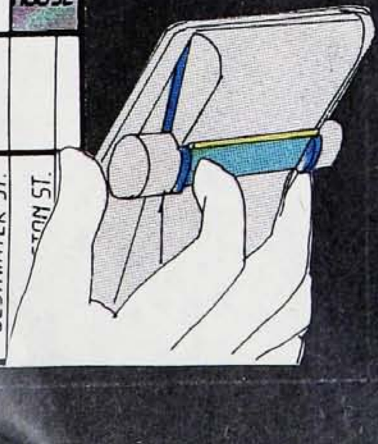






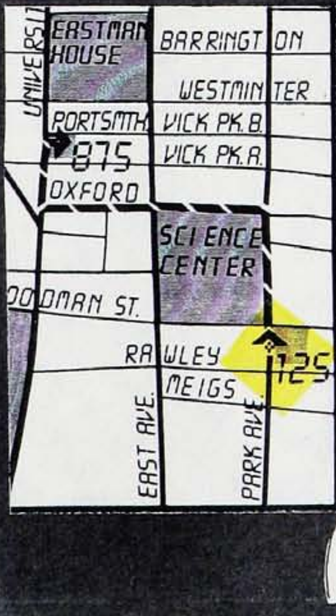
2. AREA MAP OR DESIRED AREA (from route planning)

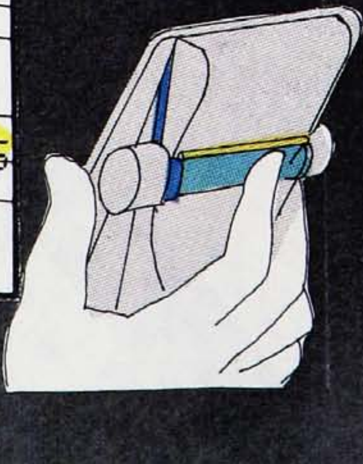




(MGF_ switch) 3.

MAGNIFIED





(NVG. switch) 4.

YOU'RE HERE

-map rotated-

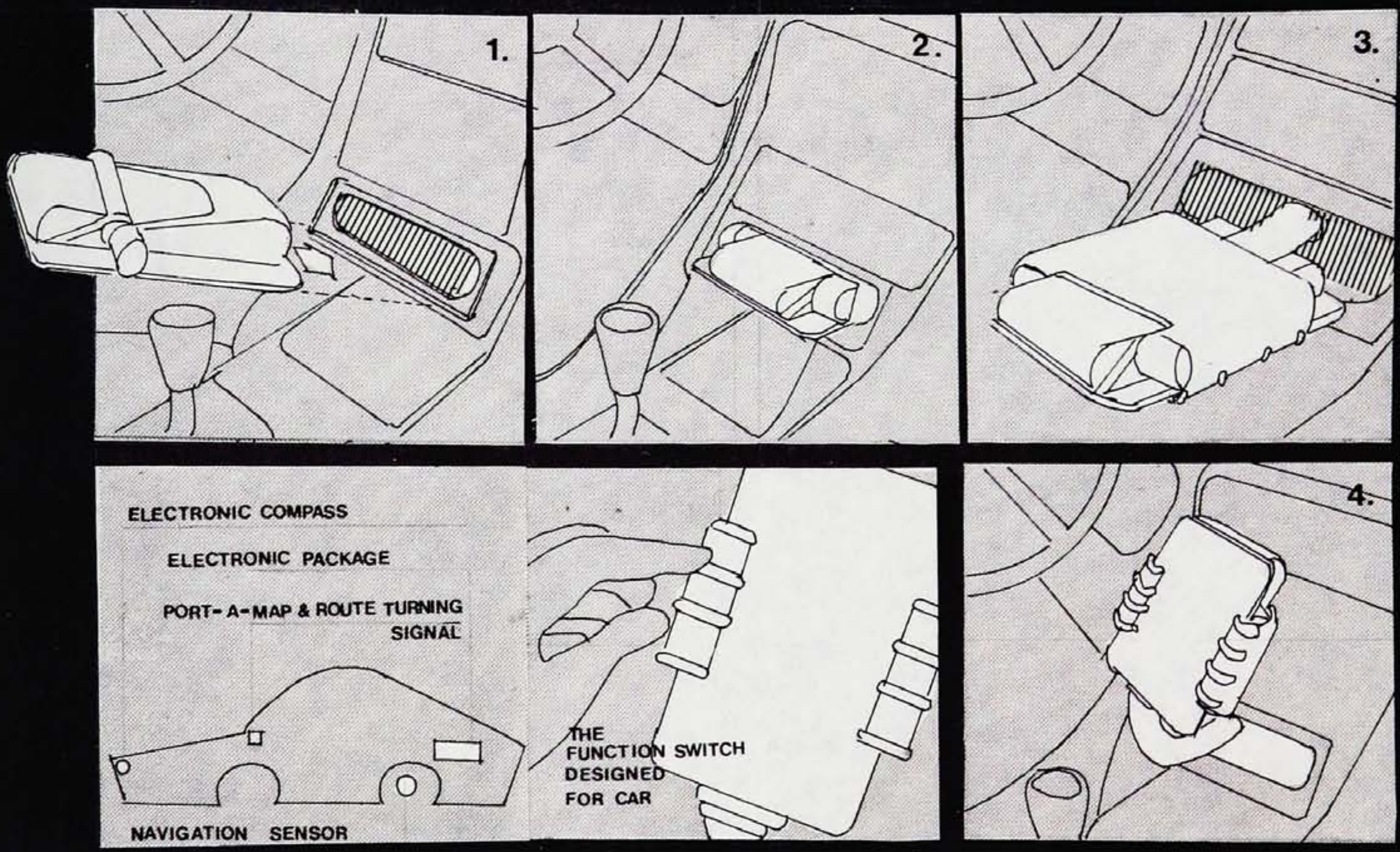
CAR MAP

While the main feature is ready use as a handy , automated tool , the Port-A-Map also is available for car use in consideration of the user who drives.

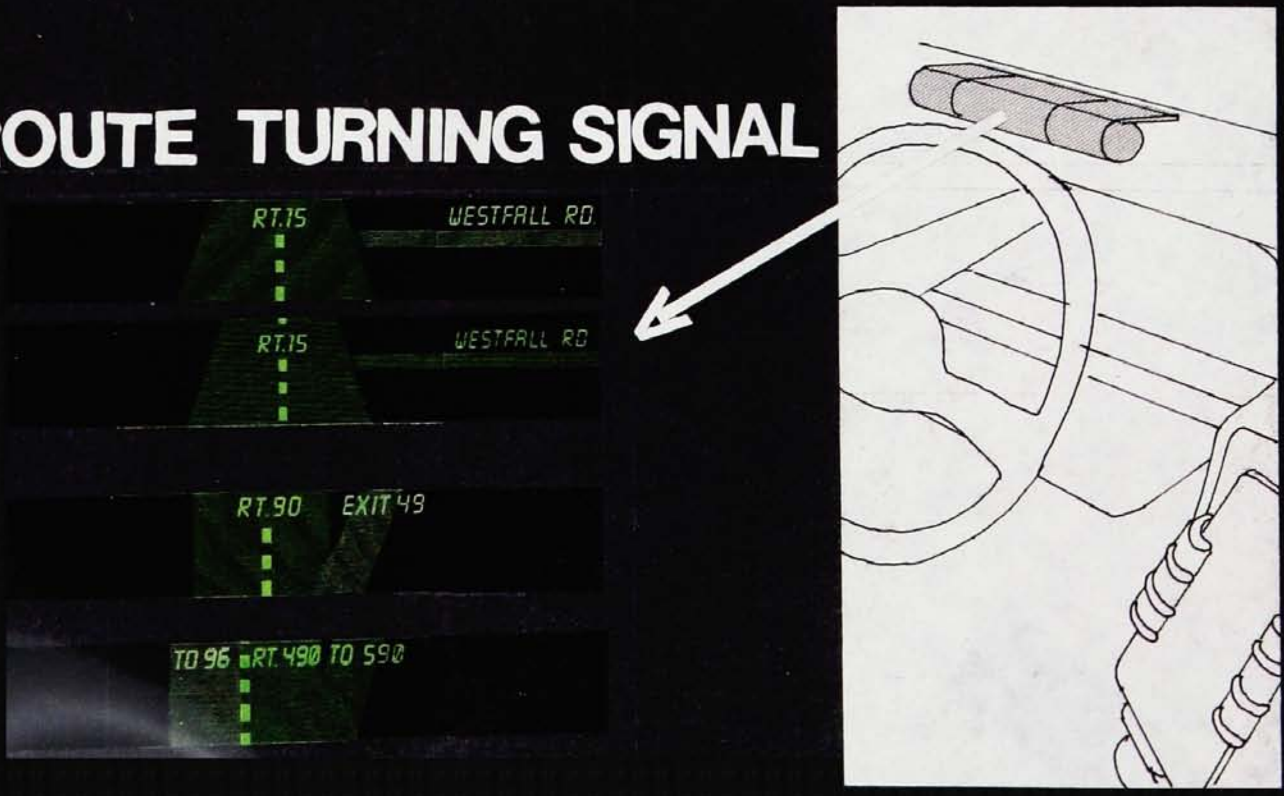
Additions needed for car use are the route turning signal which is the output channel , and a switch socket which holds the Port-A-Map and works as the data processor and the input control. Both the route turning system and the switch socket operate by being connected into the car equipped with the car navigation system. This in - vehicle system knows the vehicle 's position by dead reckoning , with a wheel sensor to measure distance , and differential wheel sensor and compass to measure heading.

This Port-A-Map feature brings more advantages , such as planning a car trip anywhere , and still keeping the users in the right direction when they leave the car and bring the Port-A-Map along.

PORT-A-MAP TO CAR MAP



ROUTE TURNING SIGNAL



MOVE WITH PORT-A-MAP

CHAPTER X

EVALUATION & IMPLEMENTATION

What Has Been Done on the Design ' The Intelligent Mapping '

1. The innovative applications of computer technology in the design

The proposal put together computer technology and advanced automated navigation system, into a mobile hand device, because the advanced technology today is able to miniaturize the size of complex components. The network station for data entry and power charge applies ideas from large information terminals and the access memory system of computers into a simpler way to distribute the stored data.

2. The traveler 's quality of life through the application of computer technology

The proposal enhances the user 's quality of life by helping him to move easier , faster and with safety. These three qualities result from the device , Port-A-Map , which was created from the application of computer technology. The technology combines the power of fast and easy access memory with the ability of a compass. The technology offers a mobile tool, gives the user freedom to travel with the device in any vehicle , thus making the trip faster and safer. The data station helps distribute these quality usages and makes the trip system into a standard network.

3. The design of human / machine interaction into product

Because humans have limited capability to perceive direction, the proposal brings the automated system to assist them ; the microprocessor is able to interpret , classify and organize arriving information effectively. This helps users to interact with tools easier , because this system does most of the perception process on direction and information for humans. The device can give the graphic route on a map or a list of turns when the user enters location and destination into the

Port-A-Map. The route turning signal is added for car use to get rid of the user 's difficulty in checking the map while driving. Humans have a limited capacity to process information , and the total demand for attention exceeds their capacity. On the dashboard , the route turning signal flashes a light and sends the sound signal to give the next turn or next exit. The information is already set in sequence , requiring a shorter time to perceive the messages. The flash turning signal provides the same information as a map without the driver having to use a map.

4. Increasing the user 's productivity

Because the user travels easier , faster , and with safety , productivity will be gained from the time saved , to do more work , to visit more places , and to have some rest A pleasant trip enables people to enjoy themselves and broaden their minds. These good things bring users happiness, which leads to more productivity in their lives.

What Needs To Be Considered in this Design

This design of the direction finding tool was developed basically by the research and creation method of an industrial designer. So, the works are the solution for the design process, not the ready model for production. As the concept creator, the designer's specific concern is with human factors and user behavior. His work is to make the right combination of realism and imagination. This design, the direction finding tool, is only the first part of the design development process. In order to achieve the complete process, after the concept creating process, the product should be implemented into the rest of the development process. This includes the prototype design and construction, final design and manufacture, and redesign. These tasks belong to the technical disciplines while the role of the industrial designer is correspondingly reduced.

One other thing we need to be concerned with is the technician who should be involved in the design of the human interaction product. Due to the complexities of the automated system, the work of man machine interface becomes more complicated. The designer who originally has little concern with technical work needs to become more involved with technicians. The complete design interaction into product can be done by getting the group of people from different disciplines working together. The technologist works on the system power, the psychologist employs scientific methods to understand the complexities of user behavior, and the designer uses intuition and common sense to develop the system to meet the user need and expectations.[1]

The Future of the Direction Finding Device

The future of the art of finding the way is an interesting subject. If the four subsystems of task analysis are used as the guideline for future predictions, the solution might be as follows: It can be said that the greatest influence on task, operator, machine and environment for today and tomorrow is advanced technology. Its capability infiltrates our machines and tools, in turn, altering the travel scenario. Travelers, tasks and their destinations have all changed in the last decade, due to the use of automated navigation. Currently, the advanced military navigation system called " The Inertial Navigation Systems " does almost all the work for the operator, from finding the right direction to steering the vehicle. In light of last example, the period of time is near when technology will have larger capabilities ; it might then move from controlling the machines and the tools to being able to control the whole environment. If the environment is in the control of the same network system, all places would be known, as well as the direction by which those places are linked, and if transportation was to be incorporated into the system, there would be no more problems of losing one's way. People would move in a direction by the systems - operated network, without traditional forms of tools, tasks or vehicles.

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[1]Vassiliou, Human Factor and Interactive Computer System, p. ix.

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